PATENT ABSTRACTS OF JAPAN

(11)Publication number : **10-116431**
(43)Date of publication of application : **06.05.1998**

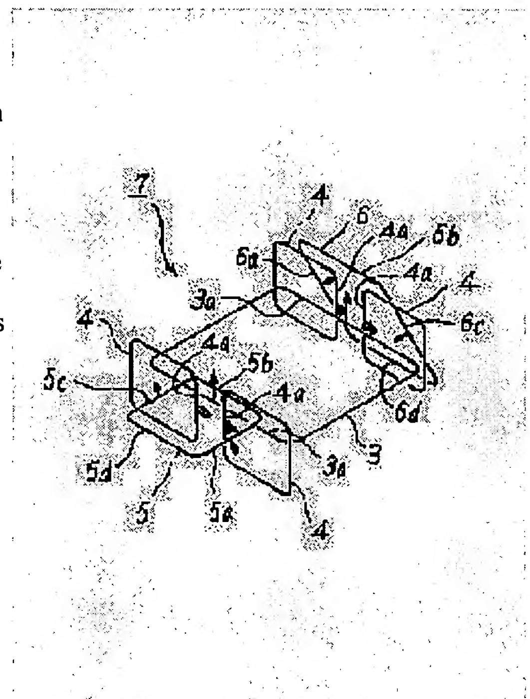
(51)Int.CI. G11B 7/095

(21)Application number : **08-268659**
(22)Date of filing : **09.10.1996**

(71)Applicant : **OLYMPUS OPTICAL CO LTD**
(72)Inventor : **IKEGAME TETSUO**

(54) OBJECTIVE LENS DRIVING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain an excellent servo characteristic by composing a tilt coil of a first part for generating turning force turning a holder around an axis crossing orthogonally the optical axial direction of an objective lens and another second part.
SOLUTION: In this objective lens driving device, sides excepting the effective sides of the tilt coils 5, 6 are placed on a position with low magnetic flux density of a magnetic gap peripheral part. Then, even when a current is allowed to flow through the tilt coils, the force moving a movable part 7 in the other direction such as the tracking direction, etc., doesn't occur. Thus, the disturbance doesn't increase in the tracking direction, focus direction and tangential direction, and a stable servo and a proper recording/reproducing signal are realized. Further, the tilt coils are reduced so that only one is used for one side magnetic gap, and the constitution can be simplified, and the cost can be reduced.



LEGAL STATUS
[Date of request for examination] 19.09.2003
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] An objective lens A holder holding said objective lens A driving means for rotating said holder to the circumference of a shaft which intersects perpendicularly to the direction of an optical axis of said objective lens It is the objective lens driving gear equipped with the above. Said driving means It consists of a magnetic field generating means and a tilt coil. Said tilt coil It consists of the 1st portion which generates rotation force of rotating said holder effective in the circumference of said shaft, and the other 2nd portion, and is characterized by arranging said 1st portion in a location where flux density within a magnetic field generated from said magnetic field generating means is higher than said 2nd portion.
[Claim 2] An objective lens A holder holding said objective lens A driving means for rotating said holder to the circumference of a shaft which intersects perpendicularly to the direction of an optical axis of said objective lens It is the objective lens driving gear equipped with the above, and said driving means consists of a magnetic field generating means and a tilt coil, and resultant force of force generated in the side which forms a tilt coil within a magnetic field generated from said magnetic field generating means in said tilt coil is characterized by constituting so that only torque of a tilt may be generated.
[Claim 3] It is the objective lens driving gear which two or more arrangement of the 1st portion of said tilt coil is carried out into said magnetic field in an objective lens driving gear according to claim 1, and is characterized by seeing from said shaft orientations and estranging rotation and said 1st portion of said holder.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is an objective lens driving gear which amends especially the inclination of the optical axis of an objective lens about the objective lens driving gear which uses information for the information record regenerative apparatus recorded or reproduced at least to optical recording data medium, such as a Magnetic-Optical disk drive, a postscript mold disk drive, a phase change mold disk drive, CD-ROM, and DVD.
[0002]
[Description of the Prior Art] To optical recording data medium, such as a Magnetic-Optical disk drive, a postscript mold disk drive, a phase change mold disk drive, CD-ROM, and DVD, the information record regenerative apparatus which records or reproduces information at least irradiates the beam spot through an objective lens at optical recording data medium, and acquires a regenerative signal and a record signal. In this case, when the optical axis of an objective lens leans to the record playback side of optical recording data medium, optical aberration may arise, a cross talk and a jitter may increase, and a regenerative signal may deteriorate. Moreover, a record signal may deteriorate at the time of record, and a mistake may be produced in pit formation.
[0003] In order to solve this problem, the following objective lens driving gears are proposed in JP,7-65397,A. As shown in drawing 17 and drawing 18 , the objective lens 101 was formed in the upper limit of the object lens holder 100, and the tilt coils 102a-102d are attached in the side of the object lens holder 100. Moreover, Magnets 104a and 104b, the U character mold yokes 105a and 105b, and the supporting material 106a-106d supported for an objective lens 101, enabling free tilting are attached in the pedestal 103. The inclination of the beam optical axis irradiated from an objective lens 101 and the recording surface of an optical disk is detected by the direction inclination detectors 107a and 107b of a path.
[0004] And based on the error signal of the inclination detectors 107a and 107b, it energizes in the tilt coils 102a-102d, and the optical axis of an objective lens 101 is amended at high speed. In this case, it is side 102a-1,102b-1,102c-1,102d-1 of an each tilt coils [102a-102d] top that the force effective in the tilt coils 102a-102d occurs. And when leaning in the direction of the direction inclination (circumference of the y-axis) arrow head A of a path, generate current in the arrow head i1 - i4 direction, a sink and each tilt coils 102a-102d are made to generate the force of arrow heads F1-F4 in each tilt coils 102a-102d, as shown in drawing 18 , and the object lens holder 100 and an objective lens 101 are leaned to the circumference of the y-axis.
[0005]
[Problem(s) to be Solved by the Invention] However, the flux density on which adjacent side 102a-2,102b-2,102c-2,102d-2 each tilt coils / 102a-102d] (drawing 18) is located in the main approach of Magnets 104a and 104b, and the objective lens driving gear shown in drawing 17 acts around there is high. Therefore, in side 102a-2,102b-2,102c-2,102d-2, the force of arrow head f (1), f (2), f (3), and f (4) occurs (drawing 18). However, in the case of inclination amendment of an objective lens, since all the force of this f (1), f (2), f (3), and f (4) is the same directions (x directions), the object lens holder 100 and an objective lens 101 will move in the x directions at the same time they incline to the circumference of the y-axis. Therefore, the disturbance of the direction of tracking increases and there is fault that the stability of a servo becomes low.
[0006] Even if this invention is proposed that said fault should be solved and performs inclination amendment of an objective lens, the optical spot of an objective lens does not move but it aims at offering the objective lens driving gear which can acquire a proper record signal and a regenerative signal.
[0007]
[Means for Solving the Problem]
1. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means consists of a magnetic field generating means and a tilt coil. Said tilt coil The 1st portion which generates rotation force of rotating said holder effective in the circumference of said shaft, It consisted of the other 2nd portion and said 1st portion was used as an objective lens driving gear arranged in a location where flux density within a magnetic field generated from said magnetic field generating means is higher than said 2nd portion.
[0008] 2. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means consisted of a magnetic field generating means and a tilt coil, and resultant force of

force generated in the side which forms a tilt coil within a magnetic field generated from said magnetic field generating means in said tilt coil used it as an objective lens driving gear constituted so that only torque of a tilt might be generated.
[0009] 3. In an objective lens driving gear according to claim 1, two or more arrangement was carried out into said magnetic field, and the 1st portion of said tilt coil was used as an objective lens driving gear with which it sees from said shaft orientations, and rotation and said 1st portion of said holder are estranged.
[0010]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to details, referring to a drawing. Drawing 1 - drawing 7 are what showed the gestalt of implementation of the 1st operation, and show the objective lens driving gear of the information record regenerative apparatus which uses a magneto-optic disk as a record medium. In addition, among the axes of coordinates in drawing, as for the direction of X, the direction of Y shows the tangential direction (tangential direction of a recording track), and the Z direction shows the direction of focusing (they are a perpendicular direction and the direction of an optical axis of an objective lens to a record-medium side) for the direction of tracking (the direction of a normal of a recording track, the access direction).
[0011] As shown in drawing 1 , a through tube can open in the center of a holder 1, and the objective lens 2 is fixed there. The slot was formed in the perimeter of the objective lens 2 by the side of Z (+) of a holder 1, and the focal coil 3 wound there in the shape of a rectangular head has fixed. Two pieces [a total of four] have fixed [the tracking coil 4 wound around the direction both sides of Y of a holder 1] at a time on the outside of the focal coil 3. Moreover, in the outside of the tracking coil 4, two wound tilt coils 5 and 6 (drawing 5) have fixed. This tilt coil is presenting the concurrency quadrilateral configuration, as shown in drawing 7 . And moving part 7 is formed with said holder 1, an objective lens 2, the focal coil 3, the tracking coil 4, and the tilt coils 5 and 6.
[0012] Furthermore, arrangement immobilization of the magnets 8 and 9 is carried out at the base 10 so that it may counter with the tilt coils 5 and 6, yokes 11 and 12 fix in the back of magnets 8 and 9, and the magnetic-flux generating means is formed. In addition, two magnets 8 and 9 are magnetized so that a like pole may face each other, as shown in drawing 1 . Moreover, the center position of the focal coil 3 of the Z direction corresponds with the center position of the Z direction of magnets 8 and 9. The sides 5a, 5c, 6a, and 6c (the 1st portion) of the slant which is the effective side counter with magnets 8 and 9, and the tilt coils 5 and 6 are located in an effective magnetic field. In addition, the effective magnetic field in the gestalt of this operation is generated to the space facing magnets 8 and 9 (drawing 5). Moreover, as compared with the center section of the magnets 8 and 9, the location where other side 5b and 6b, i.e., surfaces, and lower sides 5d and 6d (2nd portion) of the tilt coils 5 and 6 are comparable as the periphery of magnets 8 and 9, i.e., flux density, is located in a quite low place (drawing 7). That is, the slanting sides 5a, 5c, 6a, and 6c of the tilt coils 5 and 6 are located in Surfaces 5b and 6b and the place where flux density is higher than 5d and 6d.
[0013] Furthermore, height 13a is prepared in the direction both sides of X of a holder 1, and the end of the springs 14 and 15 later mentioned on Z direction both sides of this height 13a is being fixed (drawing 1). These springs 14 and 15 hold the gap of about 0.5-2mm, and come to combine the spring members 14a and 14b of two sheets, and 15a and 15b up and down, respectively. Moreover, bending section 14a-1 of a narrow width, 14b-1, 15a-1, and 15b-1 are formed near the direction both sides of Y, and bending section 14b-2 which bent crosswise (the direction of X) flank one side at the right angle, and 15b-2 (other bending sections are hidden in drawing 1) are formed between each bending section. In addition, it shifts in the direction of X slightly, and bending section 15a-1 in which the spring 15 (the same is said of a spring 14) was formed up and down, and 15b-1 are formed in it, as shown in drawing 3 .
[0014] although it is the cross section of a flat spring 15, drawing 2 is attached, as bent like illustration and mutually countered in section 15a-2 and 15b-2 -- having -- abbreviation -- the oblong rectangle is presented. And throughout the space formed by the spring members 15a and 15b, the damping materials 20, such as silicone gel and silicone grease, are poured in. Moreover, as shown in drawing 1 , the other end of flat springs 14 and 15 is being fixed to the holddown member 19 currently fixed to the Y (+) side of the base 10. And with migration of an objective lens 2, flat springs 14 and 15 deform, as shown in drawing 3 . In addition, drawing 3 (a) shows deformation before and drawing 3 (b) shows the deformation back.
[0015] Next, NP (nodal point) of an objective lens 2, the center of gravity G of moving part 7, and the relation based on [S] support are explained. Drawing 4 omits the center of the objective lens 2 in drawing 1 in respect of A-A parallel to a X-Z plane, and although it is the outline cross section which looked at it from the Y (-) side, NP of an objective lens 2 and the center of gravity G of moving part 7 are in agreement. In addition, even if it sees NP of an objective lens 2, and the center of gravity G of moving part 7 from X, they are in agreement.
[0016] Moreover, since the objective lens 2 of the gestalt of this operation is infinity optical system which is made to carry out incidence of the parallel light, and is made to condense on a disk 21, its NP corresponds with the backside (disk 21 side) principal point Ho of an objective lens 2. Furthermore, the middle point S of four bending section 14a-1 by the side of the moving part 7 of four flat springs which are supporting moving part 7, 14b-1, 15a-1, and 15b-1, i.e., a support center, is made in agreement with NP of an objective lens 2. In addition, the rotation center of the moving part 7 at the time of adding the angular moment to the surroundings of the shaft in moving part 7 is indicated to be the support center S supposing the shaft parallel to the extension direction of flat springs 14 and 15. Moreover, since rigidity of four flat springs was made the same, if the support center S becomes the four middle points, bending section 14a-1, 14b-1, 15a-1, and 15b-1, and the rigidity of four flat springs is partially changed with the gestalt of this operation The support center S shifts from the four middle points, bending section 14a-1, 14b-1, 15a-1, and 15b-1.
[0017] Next, drawing 5 explains the driving force of moving part 7. Here, each coil is expressed with the diagram. When

predetermined current is passed in the focal coil 3, the force of the direction of a focus occurs in two-side 3a which countered the magnet, and moving part 7 is made to drive in the direction of a focus. Moreover, when predetermined current is passed in four tracking coils 4, the force of the direction of tracking occurs in side 4a of the four insides, and moving part 7 is made to drive in the direction of tracking.

[0018] Next, drawing 7 explains the tilt coil 5. As described above, the tilt coil 5 is presenting the parallelogram and the surface 5b and 5d (2nd portion) of lower sides are the side to which the appearance of a magnet 8 and the sides 5a and 5c (the 1st portion) of comparable and slant connect the corner of a magnet 6, and the middle point of the direction of X. And the slanting sides 5a and 5c are seen from Y, and are estranged from the center of gravity G, the support center S, and the nodal point NP. Moreover, the middle point of the tilt coil 5 is seen from Y, and is in agreement with the center (the center of a magnetic gap, center of flux density distribution) of a center of gravity G, the support center S, a nodal point NP, and a magnet 8. In addition, while the same is said of another tilt coil 6, as two tilt coils 5 and 6 are shown in drawing 5 , the slanting side serves as reverse sense mutually.

[0019] Then, if predetermined current is passed in the tilt coil 5, the force F1 of the reverse sense and F3 will occur in parallel as shown in drawing 7 the sides 5a and 5c of two slant. In this case, since the middle point of the tilt coil 5 is in agreement with the center of a magnet 8, the force F1 and the absolute value of F3 are equal. And this force F1 and F3 give the torque of the circumference of a Y-axis about a center of gravity G (that is, the support center S, a nodal point NP), and they rotate moving part 7 the circumference of a Y-axis centering on a center of gravity G. In addition, since this force F1 and F3 have the same magnitude, it is parallel and the sense is reverse, moving part 7 is not moved to the direction of X, and a Z direction.

[0020] If F1 and F3 are furthermore decomposed into X component and Z component, Z component rotates moving part 7, and since X component is the same magnitude in the direction reverse sense of X, it will cancel it mutually. The force of the direction of an arrow head as shown in drawing 7 surface 5b and 5d of lower sides occurs, and the torque which makes the above and hard flow rotate moving part 7 by the circumference of a Y-axis is generated. Therefore, moving part 7 is not moved in each direction of X, Y, and Z according to the force generated surface 5b and 5d of lower sides. Moreover, since surface 5b and 5d of lower sides are located in the very weak place of flux density by the periphery of a magnet 8, i.e., the periphery of a magnetic gap, the force is the thing of a degree which can be disregarded weakly. In addition, also when predetermined current is passed in the tilt coil 6, moving part 7 is not moved in each direction of X, Y, and Z according to the same operation as the case of the above mentioned tilt coil 5. Therefore, even if it passes current in the tilt coils 5 and 6 and makes them rotate moving part 7, it is not made to move in each direction of X, Y, and Z.

[0021] Furthermore, when carrying out the rotation drive of the moving part 7 at the circumference of a Y-axis, on frequency lower than the resonance frequency of the circumference of a Y-axis, moving part 7 rotates the support center S as a center mostly. On the other hand, on frequency higher than the resonance frequency of the circumference of a Y-axis, moving part 7 rotates the center of gravity G as a center mostly. And with the gestalt of this operation, since NP of an objective lens 2, the center of gravity G of moving part 7, and the support center S are made in agreement, even if it rotates moving part 7 to the circumference of a Y-axis, the spot location of an objective lens 2 does not shift. Hereafter, it explains to details further, referring to drawing 6 . In addition, drawing 6 (a) is what showed the conventional condition that the center of gravity G of moving part and NP of an objective lens shifted, and drawing 6 (b) shows the condition of this example.

[0022] In drawing 6 (a), when moving part 7-1 does theta rotation of a center [the own center of gravity G] at the circumference of a Y-axis, only m moves NP of an objective lens 2 in the direction of X (2-1). That is, if distance of NP of an objective lens 2 is set to l from the center of gravity G of moving part 7-1, the movement magnitude m of Spot O will serve as m=l-theta. On the other hand, since the center of gravity G of moving part 7 and NP of an objective lens 2 are made in agreement in drawing 6 (b) of this example, even if moving part 7 inclines and an objective lens 2 inclines, moving part 7 will rotate focusing on NP. Therefore, it is set to l= 0 and set to m=l-theta =0, and Spot O does not shift in the direction of X, even if an objective lens 2 inclines. Therefore, even if it leans to the circumference of objective lens 2 Y-axis, it does not become the disturbance of the direction of tracking. Moreover, similarly, even if moving part 7 rotates centering on the support center S, Spot O does not shift in the direction of X, even if an objective lens 2 inclines. Thus, with the gestalt of this operation, even if it leans moving part 7, a spot does not move.

[0023] Since the sides other than the effective side of the tilt coils 5 and 6 were located in the place where the flux density of a magnetic gap periphery is low like the above according to the gestalt of the 1st operation, even if it passes current in a tilt coil, the force of moving moving part 7 in other directions, such as the direction of tracking, does not occur. Therefore, in the direction of tracking, the direction of a focus, and the tangential direction, disturbance does not increase but can realize the stable servo and the stable proper record regenerative signal. Moreover, the magnetic gap of one side may have few tilt coils as one, and the simplification of a configuration and low cost can be realized.

[0024] Moreover, it arranges so that each center of gravity of the focal coil 3 which fixes to a holder 1, and the tracking coil 4 may be made in agreement with NP of an objective lens 2. Since it arranged so that the fixing part slack end of the flat springs 14 and 15 which furthermore support a holder 1 might be brought close to NP of an objective lens 2 Since the balancer for center-of-gravity positioning is not needed while being able to make NP of an objective lens 2, and the center of gravity G of moving part 7 easily in agreement, small [of moving part 7] and lightweight-ization are realizable. Moreover, since the damping material was prepared between the spring members of each flat spring, the special space for being applied and filled up with a damping material is not required, but a miniaturization can be attained. Moreover, the gap of the spring member of two upper and lower sides can be narrowed.

[0025] Drawing 8 is the modification of the gestalt of the 1st operation, and with the gestalt of the 1st operation, although the

configuration of a driving means was the moving coil which fixed the coil to moving part, in this modification, it is considering as the MUBINGU magnet which prepared moving part the magnet. That is, like illustration, magnets 8 and 9 are fixed to a holder 1, and the magnetization opposes a unlike pole, forms a magnetic circuit, and makes flux density high. And it fixes to the base which is not illustrated, and the FUO dregs coil 3 is fixed to the surroundings of yokes 11 and 12, and yokes 11 and 12 fix the tracking coil 4 on winding and this FUO dregs coil 3, and are fixing the tilt coils 5 and 6 on it. About other configurations, it is the same as that of the gestalt of the 1st operation, and the same is said of an operation with each coil and a magnet. Thus, since magnets 8 and 9 are fixed to moving part 7, in case moving part 7 is made to drive, it is not necessary to supply electric power to moving part 7.

[0026] Drawing 9 shows the gestalt of operation of the 2nd of this invention. The same sign was given to the gestalt of the 1st operation, and the corresponding part (the same is said of the gestalt of the following operations). A drawing is the perspective diagram of moving part 7, and is winding four tilt coils around the corner section of a holder 1. If it sees about this tilt coil 22a, slanting side 22a-1 which faces a magnet 8 will rotate moving part 7 to the circumference of a Y-axis in the effective side. Since side 22a-2 of others and 22a-3 are separated from the magnet 8 to slanting side 22a-1, flux density is in a low location, and the force generated here can be disregarded. The same is said of other tilt coils 22b, 22c, and 22d. About an effect, it is the same as that of the gestalt of the 1st operation to other configurations and a pan.

[0027] Drawing 10 shows the modification of the gestalt of the 2nd operation. Although a drawing is the perspective diagram of moving part 7, the tilt coils 17 and 18 are wound around the circumference of the X-axis of a holder 1. And the slanting effective sides 17a, 17b, 18a, and 18b are located in the effective magnetic field of magnets 8 and 9. Since the other sides 17c, 17d, 18c, and 18d are distant from magnets 8 and 9 to the slanting sides 17a, 17b, 18a, and 18b, its flux density is low. Moreover, the other sides [17c 17d, 18c, and 18d] extension direction is perpendicular to the pole face of magnets 8 and 9. Therefore, the direction of the magnetic field which acts the other sides 17c, 17d, 18c, and 18d becomes almost parallel to the extension direction of these sides, and the force generated these sides can be disregarded. About an effect, it is the same as that of the gestalt of the 1st operation to other configurations and a pan.

[0028] Drawing 11 - drawing 15 show the gestalt of the 3rd operation. As shown in the perspective diagram of the driving gear of drawing 11 , the objective lens 2 has fixed in the hole of the center of a holder 1. Moreover, printed coils 23 and 24 have fixed in the direction side of Y of a holder 1. These printed coils 23 and 24 are three-tiered structures, sequentially from the direction near the magnets 8 and 9 which face each other, respectively, the TORATTO king coil 4 of two focal coil [3 or 1] and the tilt coil 5 (6) are formed, and the whole is hardened by resin, such as a rigid high epoxy resin. And moving part 7 consists of a holder 1, an objective lens 2, and printed coils 23 and 24.

[0029] Furthermore, the spring sheet 25 which etches the conductive high metallic foil of RYUMU copper etc. very, and changes has three springs 26 of the center which extends in the direction of Y, the three connection sections 27 which similarly extend in the direction of Y, and two connections 28 located in the direction both ends of Y. Thus, the constituted spring sheet 25 positions the direction end of Y(-) to slot 23a formed in the six direction both-sides sides of X of a printed coil 23 each, and soldering immobilization is carried out at the pattern of the copper formed around slot 23a. Moreover, the direction other end of Y(+) of the three connection sections 27 of the spring sheet 25 is positioned by slot 24a formed in the three direction both-sides sides of X of a printed coil 24 each, and adhesion immobilization is carried out. Moreover, the other end of three springs 26 of the spring sheet 25 is positioned and fixed to slot 10b-1 formed in the Y (+) side of the base 10. And it is soldered to the flexible substrate 29 fixed to the field by the side of holddown-member 10Y of b (+) fixed to the base 10. In addition, the other end of a spring 26 may be fixed to the flexible substrate 29 only with soldering. After such an activity, the connection 28 of the spring sheet 25 is cut (A in drawing 12 and the B section are the cut section), and is divided into the connection section 27 of three springs [26 or 3].

[0030] It connects electrically in a total of six connection sections 27 between two printed coils 23 and 24 as mentioned above. That is, a total of six terminals of each two terminals of every of the focal coil 3 formed in the printed coil 24, the TORATTO king coil 4, and the tilt coil 6 are connected to a printed coil 23 by the connection section 27. Moreover, magnets 8 and 9 magnetized the two poles of the directions of X, fixed yokes 11 and 12 to the back, and have fixed the base to fixed part 10a of the base 10. Moreover, a unlike pole faces each other, and two magnets 8 and 9 are magnetized so that the flux density of a magnetic gap may be raised.

[0031] Next, a drive of moving part 7 is explained. If current is passed in the focal coil 3, the driving force of the direction of a focus will occur in cooperation with the magnetic field which magnets 8 and 9 generate, a total of six springs 26 of the spring sheet 25 will bend, and moving part 7 will be moved in the direction of a focus. Moreover, if current is passed in the TORATTO king coil 4, in cooperation with the magnetic field which magnets 8 and 9 generate, the driving force of the direction of a TORATTO king will occur, a total of six springs 26 will bend, and moving part 7 will be moved in the direction of tracking. Moreover, if current is passed in the tilt coil 5, the torque of the circumference of a Y-axis will occur in cooperation with the magnetic field which magnets 8 and 9 generate, a total of six springs 26 will bend, and moving part 7 will be rotated to the circumference of a Y-axis.

[0032] Next, an operation with a magnet and each coil is explained. Drawing 14 and drawing 15 show flux density distribution of a magnetic gap with a magnet. Among these, drawing 14 shows distribution of the direction of X of the Z direction center section of the magnetic gap, i.e., the flux density distribution of line P-P shown in drawing 13 (a), (the same is said of the magnetic field distribution). said -- it carried out -- as -- a magnet -- the direction of X -- 2 -- since it has magnetized very much, the direction of magnetic flux is reversed in the center like illustration, and there are two peaks. That is, the flux density of the part where 2 lists, and the both ends of a magnet and a magnetic field change [an effective magnetic

field] in the direction of X is low. Moreover, drawing 15 shows distribution of the Z direction of the direction center section of X of the magnetic gap, i.e., the flux density distribution of line Q-Q shown in drawing 13 (a), (the same is said of the magnetic field distribution). According to this, flux density is low at the both ends of a magnet.

[0033] Next, the force generated in each coil according to drawing 13 is explained. It has stood in a line in the two directions of X, and, as for the focal coil 3, each faces the pole face where magnets 8 and 9 are magnetized two poles. And the Z direction center position of the surface 3a is the same as the Z direction center position of a magnet 8. Lower side 3c is located below the effective magnetic field range of a magnet 8 (2 each appearance of a magnet 8 magnetized very much).

[0034] Then, the force generated when current is passed in the focal coil 3 becomes like drawing 13 (a). And the effective force of a Z direction occurs in surface 3a located in an effective magnetic field midrange, and moving part 7 is moved in the direction of a focus. Since the sides 3b and 3d parallel to the Z-axis of the focal coil 3 are located in the periphery section of an effective magnetic field range at this time, the magnetic field which acts those sides is weak. Moreover, although the force as shown in drawing 13 (a) occurs the sides 3b and 3d, it will cancel with two focal coils of the direction of X. Moreover, since it is outside an effective magnetic field range, the force generated in lower side 3c of the focal coil 3 can disregard the force very weakly.

[0035] Furthermore, as for the tracking coil 4, the center position of the Z direction has become the same as the center position of the Z direction of a magnet 8. Moreover, the effective sides 4a and 4d parallel to the Z-axis of the tracking coil 4 are located in the center of an effective magnetic field in which two magnets 8 were magnetized. Then, if current is passed in the tracking coil 4, the sense of the current which flows the effective sides 4a and 4d as shown in drawing 13 (b) is reverse, and since the sense of a magnetic field is also reverse, the force will occur in the same direction of the direction of X. Moreover, although the force as shown in drawing 13 (b), respectively occurs in parallel to direction of X side 4b, and 4f, 4c and 4e, each will cancel.

[0036] Furthermore, as for the tilt coil 5, the center position of the Z direction of the surfaces 5a and 5b has become the same as the center position of the Z direction of a magnet 8. Moreover, the lower sides 5d and 5e are located below the effective magnetic field range of a magnet 8 (2 each appearance of a magnet 8 magnetized very much). Moreover, the sides 5c and 5f parallel to a Z direction are located in the periphery section of an effective magnetic field range. Then, if current is passed in the tilt coil 5, as shown in drawing 13 (c), the force of the reverse sense will occur in a Z direction in the surfaces 5a and 5b located in an effective magnetic field midrange, and the rotation drive of the moving part 7 will be carried out at the circumference of a Y-axis. And the center of gravity G of moving part 7, the support center S, and the nodal point NP of an objective lens are in agreement in the middle of Surfaces 5a and 5b. Therefore, even if it makes it rotate centering on the center of rotation of moving part 7, the spot of an objective lens does not move.

[0037] Moreover, since the sides 5c and 5f parallel to the Z-axis of the tilt coil 5 are located in the periphery section of an effective magnetic field range, they are weak. [of the magnetic field which acts around there] Therefore, the force generated the sides 5c and 5f is the degree which can be disregarded although it is the direction same in the direction of X. Moreover, since the lower sides 5d and 5e are located below the effective magnetic field range of a magnet 8, they are very weak. [of the force generated there] In addition, if the sides 5c and 5f are located outside the effective magnetic field range of a magnet 8, since a magnetic field becomes still weaker, it is much more effective. Moreover, although three kinds of coils were used as the printed coil, they may form each coil by winding and may paste it up on a holder. Moreover, it replaces with the magnet of 2 pole magnetization, and the sense of a magnetic pole may be made into reverse and two magnets may be combined.

[0038] Since the servo which was stabilized according to the gestalt of the 3rd operation, and a proper record regenerative signal can be done like the above and also two sides parallel to the Z direction of a tracking coil are located in the direction of X in an effective magnetic field using the magnet magnetized two poles, the use effectiveness of a tracking coil becomes high and the drive sensitivity of the direction of tracking becomes high. Moreover, since electric connection between two the focal coils of a printed coil, tracking coils, and tilt coils is made by the spring and the connection section formed in one and he is trying to separate the connection section after that, the substrate which connects between coils becomes unnecessary. Moreover, since three springs and the three connection sections are united with the spring sheet using two connections, there are few components mark at the time of an assembly, and positioning is easy. Moreover, since there is no opening in which a yoke is located in a holder, the rigidity of a holder is high and can make resonance frequency high.

[0039] Drawing 16 shows the modification of the gestalt of the 3rd operation. This uses a focal coil also [drive / the object for a focal drive, and / tilt] not using a tilt coil. It is made for the force of the reverse sense to generate predetermined current in a Z direction in a sink focus coil at each of four focal coils 30a, 30b, 30c, and 30d. Then, moving part 7 receives the torque of the circumference of a Y-axis, and rotates to the circumference of a Y-axis. At this time, force like illustration arises in each focal coils [30a, 30b, 30c, and 30d] side. Three sides other than side 30a-1 which generates the effective force, 30b-1, and 30c-130d-1 are located in the periphery of an effective magnetic field range, or outside as the gestalt of the 3rd operation explained. Therefore, the force produced in these side 30a-2, 30a-3, 30a-4, 30b-2, 30b-3, 30b-4, 30c-2, 30c-3, 30c-4, 30d-2, 30d-3, and 30d-4 is small. Therefore, the force which moves the sink moving part 7 for it to them in the direction of X even if it leans current to the focal coils 30a, 30b, 30c, and 30d at the circumference of a Y-axis is very weak.

[0040] Moreover, if current is passed in each focal coil so that the force of the same direction may occur in a Z direction in four focal coils 30a, 30b, 30c, and 30d, moving part 7 is movable in the direction of a focus. Moreover, in each focal coil, it passes combining focus servo current and tilt servo current. Like the above, according to this modification, in addition to the effect of the gestalt of the 3rd operation, one kind of class of coil decreases, and simplification of a configuration can be attained.

[0041] This invention is not limited to the gestalt of the above operation, and can consider various modification and deformation. For example, in the gestalt of each operation, although NP of an objective lens is made in agreement focusing on the center of gravity of moving part, or support, if a center of gravity or a support center sets it as the degree located in the interior of an objective lens, the gap can make a minute amount extremely about 0-2mm and migration of the optical spot by the inclination of moving part since it is small. Moreover, although it constitutes so that moving part may be leaned to the circumference of a Y-axis, it may be made to lean to the circumference of the X-axis, and a tilt coil is prepared 2 sets and you may make it lean it to a 2-way. Moreover, although considered as the open magnetic circuit which it hits, and there is no yoke for which a magnetic circuit is formed, and which counters a magnet, and forms a magnetic gap only with a magnet, it is good also as a close magnetic circuit which arranges a yoke and forms a magnetic gap between this yoke so that a magnet may be countered. By carrying out like this, flux density becomes high and improvement in sensitivity can be aimed at. Moreover, although considered as the so-called moving coil drive which fixed the coil to moving part and arranged the magnet in the fixed part, it is good also as the so-called MUBINGU magnet drive which fixed the magnet to moving part and arranged the coil in the fixed part. Moreover, supporter material may be other members, such as a wire, and with [the number] two [or more], it is good by the number suitably. Moreover, a hologram is sufficient as an objective lens and the objective lens and the holder may really be formed. Moreover, the light source of laser etc. may be made to really form in moving part.
[0042] The contents indicated by the gestalt of the above operation can also be regarded as the following invention.
1. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means consists of a magnetic field generating means and a tilt coil. Said tilt coil The 1st portion which generates the rotation force of rotating said holder effective in the circumference of said shaft, It is the objective lens driving gear which consists of the other 2nd portion and is characterized by arranging said 1st portion in the location where the flux density within the magnetic field generated from said magnetic field generating means is higher than said 2nd portion.

[0043] 2. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means is an objective lens driving gear characterized by resultant force of the force generated in the side which forms the tilt coil within the magnetic field which consists of a magnetic field generating means and a tilt coil, and is generated from said magnetic field generating means in said tilt coil constituting so that only the torque of a tilt may be generated.
[0044] 3. It is the objective lens driving gear which two or more arrangement of the 1st portion of said tilt coil is carried out into said magnetic field in the objective lens driving gear of the 1st publication, and is characterized by seeing from said shaft orientations and estranging rotation and said 1st portion of said holder.
[0045] 4. It is the objective lens driving gear characterized by being aslant arranged so that driving force may be generated at the 2-way of the direction where the direction of an optical axis of said objective lens and it, and the 1st portion of said tilt coil cross said holder at right angles in an objective lens driving gear given [said] in the 3rd term.
[0046] 5. It is the objective lens driving gear characterized by for the direction which the 1st portion of said tilt coil is in the field which intersects perpendicularly with said shaft, and intersects perpendicularly with the direction of an optical axis of said objective lens and it extending along a different direction in an objective lens driving gear given [said] in the 3rd term, and being arranged.
[0047] 6. It is the objective lens driving gear characterized by for the magnetic pole from which said magnetic field generating means differs adjoining mutually in an objective lens driving gear given [said] in the 1st term, forming it, and giving two different magnetic fields to the 1st portion of said tilt coil.
[0048] 7. It is the objective lens driving gear which said driving means has the focal coil and tracking coil for making said holder drive in the direction which intersects perpendicularly to the direction of an optical axis and this optical-axis direction of said objective lens further in an objective lens driving gear given in said the 1st thru/or 6th term, and is characterized by having arranged the 1st portion of said tilt coil in piles on said focal coil or a tracking coil.
[0049] 8. It is the objective lens driving gear which said magnet fixes to said holder in an objective lens driving gear given in said the 1st thru/or 7th term, and is characterized by arranging said tilt coil at a fixed part side.
[0050] 9. Objective lens driving gear characterized by having two or more elastic support members which support said holder elastically, and center between said two or more elastic support members and rotation center of said holder being in agreement in objective lens driving gear given in said the 1st thru/or 8th term.
[0051] 10. It is the objective lens driving gear characterized by the rotation center of said holder being in agreement with the nodal point of said objective lens in an objective lens driving gear given in said the 1st thru/or 9th term.
[0052]
[Effect of the Invention] According to this invention, the following effects are done so as explained above. By having arranged the 1st portion which generates the rotation force of rotating the holder of a tilt coil effectively rather than a part for other part II in the high location of whenever [within the magnetic field generated from a magnetic field generating means / magnetic-flux] according to the objective lens driving gear of claim 1, even if any force other than the force of making a tilt coil rotating moving part does not occur or it generates, it is very small. Therefore, since pole small deer migration of whether moving part moves other than rotation is not carried out, even if it performs inclination amendment of an objective lens, the spot of an objective lens does not move, big disturbance does not occur in the direction of tracking etc., but a good servo

property and a proper record regenerative signal come to be acquired.
[0053] Since according to the objective lens driving gear of claim 2 resultant force of the force generated in the side which forms the tilt coil in the magnetic gap in which said magnetic field generating means generates a tilt coil constitutes so that only the torque of a tilt may be generated, it is very small, even if any force other than the force of making a tilt coil rotating moving part does not occur or it generates. Therefore, since pole small deer migration of whether moving part moves other than rotation is not carried out, even if it performs inclination amendment of an objective lens, the spot of an objective lens does not move, big disturbance does not occur in the direction of tracking etc., but a good servo property and a proper record regenerative signal come to be acquired.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention is an objective lens driving gear which amends especially the inclination of the optical axis of an objective lens about the objective lens driving gear which uses information for the information record regenerative apparatus recorded or reproduced at least to optical recording data medium, such as a Magnetic-Optical disk drive, a postscript mold disk drive, a phase change mold disk drive, CD-ROM, and DVD.

[Translation done.]

PRIOR ART

[Description of the Prior Art] To optical recording data medium, such as a Magnetic-Optical disk drive, a postscript mold disk drive, a phase change mold disk drive, CD-ROM, and DVD, the information record regenerative apparatus which records or reproduces information at least irradiates the beam spot through an objective lens at optical recording data medium, and acquires a regenerative signal and a record signal. In this case, when the optical axis of an objective lens leans to the record playback side of optical recording data medium, optical aberration may arise, a cross talk and a jitter may increase, and a regenerative signal may deteriorate. Moreover, a record signal may deteriorate at the time of record, and a mistake may be produced in pit formation.
[0003] In order to solve this problem, the following objective lens driving gears are proposed in JP,7-65397,A. As shown in drawing 17 and drawing 18 , the objective lens 101 was formed in the upper limit of the object lens holder 100, and the tilt coils 102a-102d are attached in the side of the object lens holder 100. Moreover, Magnets 104a and 104b, the U character mold yokes 105a and 105b, and the supporting material 106a-106d supported for an objective lens 101, enabling free tilting are attached in the pedestal 103. The inclination of the beam optical axis irradiated from an objective lens 101 and the recording surface of an optical disk is detected by the direction inclination detectors 107a and 107b of a path.
[0004] And based on the error signal of the inclination detectors 107a and 107b, it energizes in the tilt coils 102a-102d, and the optical axis of an objective lens 101 is amended at high speed. In this case, it is side 102a-1,102b-1,102c-1,102d-1 of an each tilt coils [102a-102d] top that the force effective in the tilt coils 102a-102d occurs. And when leaning in the direction of the direction inclination (circumference of the y-axis) arrow head A of a path, generate current in the arrow head i1 - i4 direction, a sink and each tilt coils 102a-102d are made to generate the force of arrow heads F1-F4 in each tilt coils 102a-102d, as shown in drawing 18 , and the object lens holder 100 and an objective lens 101 are leaned to the circumference of the y-axis.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the following effects are done so as explained above. By having arranged the 1st portion which generates the rotation force of rotating the holder of a tilt coil effectively rather than a part for other part II in the high location of whenever [within the magnetic field generated from a magnetic field generating means / magnetic-flux] according to the objective lens driving gear of claim 1, even if any force other than the force of making a tilt coil rotating moving part does not occur or it generates, it is very small. Therefore, since pole small deer migration of whether moving part moves other than rotation is not carried out, even if it performs inclination amendment of an objective lens, the spot of an objective lens does not move, big disturbance does not occur in the direction of tracking etc., but a good servo property and a proper record regenerative signal come to be acquired.
[0053] Since according to the objective lens driving gear of claim 2 resultant force of the force generated in the side which forms the tilt coil in the magnetic gap in which said magnetic field generating means generates a tilt coil constitutes so that only the torque of a tilt may be generated, it is very small, even if any force other than the force of making a tilt coil rotating moving part does not occur or it generates. Therefore, since pole small deer migration of whether moving part moves other than rotation is not carried out, even if it performs inclination amendment of an objective lens, the spot of an objective lens does not move, big disturbance does not occur in the direction of tracking etc., but a good servo property and a proper record regenerative signal come to be acquired.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the flux density on which adjacent side 102a-2,102b-2,102c-2,102d-2 each tilt coils / 102a-102d] (drawing 18) is located in the main approach of Magnets 104a and 104b, and the objective lens driving gear shown in drawing 17 acts around there is high. Therefore, in side 102a-2,102b-2,102c-2,102d-2, the force of arrow head f (1), f (2), f (3), and f (4) occurs (drawing 18). However, in the case of inclination amendment of an objective lens, since all the force of this f (1), f (2), f (3), and f (4) is the same directions (x directions), the object lens holder 100 and an objective lens 101 will move in the x directions at the same time they incline to the circumference of the y-axis. Therefore, the disturbance of the direction of tracking increases and there is fault that the stability of a servo becomes low.
[0006] Even if this invention is proposed that said fault should be solved and performs inclination amendment of an objective lens, the optical spot of an objective lens does not move but it aims at offering the objective lens driving gear which can acquire a proper record signal and a regenerative signal.

[Translation done.]

MEANS

[Means for Solving the Problem]
1. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means consists of a magnetic field generating means and a tilt coil. Said tilt coil The 1st portion which generates rotation force of rotating said holder effective in the circumference of said shaft, It consisted of the other 2nd portion and said 1st portion was used as an objective lens driving gear arranged in a location where flux density within a magnetic field generated from said magnetic field generating means is higher than said 2nd portion.
[0008] 2. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means consisted of a magnetic field generating means and a tilt coil, and resultant force of force generated in the side which forms a tilt coil within a magnetic field generated from said magnetic field generating means in said tilt coil used it as an objective lens driving gear constituted so that only torque of a tilt might be generated.
[0009] 3. In an objective lens driving gear according to claim 1, two or more arrangement was carried out into said magnetic field, and the 1st portion of said tilt coil was used as an objective lens driving gear with which it sees from said shaft orientations, and rotation and said 1st portion of said holder are estranged.
[0010]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to details, referring to a drawing. Drawing 1 - drawing 7 are what showed the gestalt of implementation of the 1st operation, and show the objective lens driving gear of the information record regenerative apparatus which uses a magneto-optic disk as a record medium. In addition, among the axes of coordinates in drawing, as for the direction of X, the direction of Y shows the tangential direction (tangential direction of a recording track), and the Z direction shows the direction of focusing (they are a perpendicular direction and the direction of an optical axis of an objective lens to a record-medium side) for the direction of tracking (the direction of a normal of a recording track, the access direction).
[0011] As shown in drawing 1 , a through tube can open in the center of a holder 1, and the objective lens 2 is fixed there. The slot was formed in the perimeter of the objective lens 2 by the side of Z (+) of a holder 1, and the focal coil 3 wound there in the shape of a rectangular head has fixed. Two pieces [a total of four] have fixed [the tracking coil 4 wound around the direction both sides of Y of a holder 1] at a time on the outside of the focal coil 3. Moreover, in the outside of the tracking coil 4, two wound tilt coils 5 and 6 (drawing 5) have fixed. This tilt coil is presenting the concurrency quadrilateral configuration, as shown in drawing 7 . And moving part 7 is formed with said holder 1, an objective lens 2, the focal coil 3, the tracking coil 4, and the tilt coils 5 and 6.
[0012] Furthermore, arrangement immobilization of the magnets 8 and 9 is carried out at the base 10 so that it may counter with the tilt coils 5 and 6, yokes 11 and 12 fix in the back of magnets 8 and 9, and the magnetic-flux generating means is formed. In addition, two magnets 8 and 9 are magnetized so that a like pole may face each other, as shown in drawing 1 . Moreover, the center position of the focal coil 3 of the Z direction corresponds with the center position of the Z direction of magnets 8 and 9. The sides 5a, 5c, 6a, and 6c (the 1st portion) of the slant which is the effective side counter with magnets 8 and 9, and the tilt coils 5 and 6 are located in an effective magnetic field. In addition, the effective magnetic field in the gestalt of this operation is generated to the space facing magnets 8 and 9 (drawing 5). Moreover, as compared with the center section of the magnets 8 and 9, the location where other side 5b and 6b, i.e., surfaces, and lower sides 5d and 6d (2nd portion) of the tilt coils 5 and 6 are comparable as the periphery of magnets 8 and 9, i.e., flux density, is located in a quite low place (drawing 7). That is, the slanting sides 5a, 5c, 6a, and 6c of the tilt coils 5 and 6 are located in Surfaces 5b and 6b and the place where flux density is higher than 5d and 6d.
[0013] Furthermore, height 13a is prepared in the direction both sides of X of a holder 1, and the end of the springs 14 and 15 later mentioned on Z direction both sides of this height 13a is being fixed (drawing 1). These springs 14 and 15 hold the gap of about 0.5-2mm, and come to combine the spring members 14a and 14b of two sheets, and 15a and 15b up and down, respectively. Moreover, bending section 14a-1 of a narrow width, 14b-1, 15a-1, and 15b-1 are formed near the direction both sides of Y, and bending section 14b-2 which bent crosswise (the direction of X) flank one side at the right angle, and 15b-2 (other bending sections are hidden in drawing 1) are formed between each bending section. In addition, it shifts in the direction of X slightly, and bending section 15a-1 in which the spring 15 (the same is said of a spring 14) was formed up and down, and 15b-1 are formed in it, as shown in drawing 3 .

[0014] although it is the cross section of a flat spring 15, drawing 2 is attached, as bent like illustration and mutually countered in section 15a-2 and 15b-2 -- having -- abbreviation -- the oblong rectangle is presented. And throughout the space formed by the spring members 15a and 15b, the damping materials 20, such as silicone gel and silicone grease, are poured in. Moreover, as shown in drawing 1 , the other end of flat springs 14 and 15 is being fixed to the holddown member 19 currently fixed to the Y (+) side of the base 10. And with migration of an objective lens 2, flat springs 14 and 15 deform, as shown in drawing 3 . In addition, drawing 3 (a) shows deformation before and drawing 3 (b) shows the deformation back.
[0015] Next, NP (nodal point) of an objective lens 2, the center of gravity G of moving part 7, and the relation based on [S] support are explained. Drawing 4 omits the center of the objective lens 2 in drawing 1 in respect of A-A parallel to a X-Z plane, and although it is the outline cross section which looked at it from the Y (-) side, NP of an objective lens 2 and the center of gravity G of moving part 7 are in agreement. In addition, even if it sees NP of an objective lens 2, and the center of gravity G of moving part 7 from X, they are in agreement.
[0016] Moreover, since the objective lens 2 of the gestalt of this operation is infinity optical system which is made to carry out incidence of the parallel light, and is made to condense on a disk 21, its NP corresponds with the backside (disk 21 side) principal point Ho of an objective lens 2. Furthermore, the middle point S of four bending section 14a-1 by the side of the moving part 7 of four flat springs which are supporting moving part 7, 14b-1, 15a-1, and 15b-1, i.e., a support center, is made in agreement with NP of an objective lens 2. In addition, the rotation center of the moving part 7 at the time of adding the angular moment to the surroundings of the shaft in moving part 7 is indicated to be the support center S supposing the shaft parallel to the extension direction of flat springs 14 and 15. Moreover, since rigidity of four flat springs was made the same, if the support center S becomes the four middle points, bending section 14a-1, 14b-1, 15a-1, and 15b-1, and the rigidity of four flat springs is partially changed with the gestalt of this operation The support center S shifts from the four middle points, bending section 14a-1, 14b-1, 15a-1, and 15b-1.
[0017] Next, drawing 5 explains the driving force of moving part 7. Here, each coil is expressed with the diagram. When predetermined current is passed in the focal coil 3, the force of the direction of a focus occurs in two-side 3a which countered the magnet, and moving part 7 is made to drive in the direction of a focus. Moreover, when predetermined current is passed in four tracking coils 4, the force of the direction of tracking occurs in side 4a of the four insides, and moving part 7 is made to drive in the direction of tracking.
[0018] Next, drawing 7 explains the tilt coil 5. As described above, the tilt coil 5 is presenting the parallelogram and the surface 5b and 5d (2nd portion) of lower sides are the side to which the appearance of a magnet 8 and the sides 5a and 5c (the 1st portion) of comparable and slant connect the corner of a magnet 6, and the middle point of the direction of X. And the slanting sides 5a and 5c are seen from Y, and are estranged from the center of gravity G, the support center S, and the nodal point NP. Moreover, the middle point of the tilt coil 5 is seen from Y, and is in agreement with the center (the center of a magnetic gap, center of flux density distribution) of a center of gravity G, the support center S, a nodal point NP, and a magnet 8. In addition, while the same is said of another tilt coil 6, as two tilt coils 5 and 6 are shown in drawing 5 , the slanting side serves as reverse sense mutually.
[0019] Then, if predetermined current is passed in the tilt coil 5, the force F1 of the reverse sense and F3 will occur in parallel as shown in drawing 7 the sides 5a and 5c of two slant. In this case, since the middle point of the tilt coil 5 is in agreement with the center of a magnet 8, the force F1 and the absolute value of F3 are equal. And this force F1 and F3 give the torque of the circumference of a Y-axis about a center of gravity G (that is, the support center S, a nodal point NP), and they rotate moving part 7 the circumference of a Y-axis centering on a center of gravity G. In addition, since this force F1 and F3 have the same magnitude, it is parallel and the sense is reverse, moving part 7 is not moved to the direction of X, and a Z direction.
[0020] If F1 and F3 are furthermore decomposed into X component and Z component, Z component rotates moving part 7, and since X component is the same magnitude in the direction reverse sense of X, it will cancel it mutually. The force of the direction of an arrow head as shown in drawing 7 surface 5b and 5d of lower sides occurs, and the torque which makes the above and hard flow rotate moving part 7 by the circumference of a Y-axis is generated. Therefore, moving part 7 is not moved in each direction of X, Y, and Z according to the force generated surface 5b and 5d of lower sides. Moreover, since surface 5b and 5d of lower sides are located in the very weak place of flux density by the periphery of a magnet 8, i.e., the periphery of a magnetic gap, the force is the thing of a degree which can be disregarded weakly. In addition, also when predetermined current is passed in the tilt coil 6, moving part 7 is not moved in each direction of X, Y, and Z according to the same operation as the case of the above mentioned tilt coil 5. Therefore, even if it passes current in the tilt coils 5 and 6 and makes them rotate moving part 7, it is not made to move in each direction of X, Y, and Z.
[0021] Furthermore, when carrying out the rotation drive of the moving part 7 at the circumference of a Y-axis, on frequency lower than the resonance frequency of the circumference of a Y-axis, moving part 7 rotates the support center S as a center mostly. On the other hand, on frequency higher than the resonance frequency of the circumference of a Y-axis, moving part 7 rotates the center of gravity G as a center mostly. And with the gestalt of this operation, since NP of an objective lens 2, the center of gravity G of moving part 7, and the support center S are made in agreement, even if it rotates moving part 7 to the circumference of a Y-axis, the spot location of an objective lens 2 does not shift. Hereafter, it explains to details further, referring to drawing 6 . In addition, drawing 6 (a) is what showed the conventional condition that the center of gravity G of moving part and NP of an objective lens shifted, and drawing 6 (b) shows the condition of this example.
[0022] In drawing 6 (a), when moving part 7-1 does theta rotation of a center [the own center of gravity G] at the circumference of a Y-axis, only m moves NP of an objective lens 2 in the direction of X (2-1). That is, if distance of NP of an objective lens 2 is set to l from the center of gravity G of moving part 7-1, the movement magnitude m of Spot O will serve as

m=l-theta. On the other hand, since the center of gravity G of moving part 7 and NP of an objective lens 2 are made in agreement in drawing 6 (b) of this example, even if moving part 7 inclines and an objective lens 2 inclines, moving part 7 will rotate focusing on NP. Therefore, it is set to l= 0 and set to m=l-theta =0, and Spot O does not shift in the direction of X, even if an objective lens 2 inclines. Therefore, even if it leans to the circumference of objective lens 2 Y-axis, it does not become the disturbance of the direction of tracking. Moreover, similarly, even if moving part 7 rotates centering on the support center S, Spot O does not shift in the direction of X, even if an objective lens 2 inclines. Thus, with the gestalt of this operation, even if it leans moving part 7, a spot does not move.

[0023] Since the sides other than the effective side of the tilt coils 5 and 6 were located in the place where the flux density of a magnetic gap periphery is low like the above according to the gestalt of the 1st operation, even if it passes current in a tilt coil, the force of moving moving part 7 in other directions, such as the direction of tracking, does not occur. Therefore, in the direction of tracking, the direction of a focus, and the tangential direction, disturbance does not increase but can realize the stable servo and the stable proper record regenerative signal. Moreover, the magnetic gap of one side may have few tilt coils as one, and the simplification of a configuration and low cost can be realized.

[0024] Moreover, it arranges so that each center of gravity of the focal coil 3 which fixes to a holder 1, and the tracking coil 4 may be made in agreement with NP of an objective lens 2. Since it arranged so that the fixing part slack end of the flat springs 14 and 15 which furthermore support a holder 1 might be brought close to NP of an objective lens 2 Since the balancer for center-of-gravity positioning is not needed while being able to make NP of an objective lens 2, and the center of gravity G of moving part 7 easily in agreement, small [of moving part 7] and lightweight-ization are realizable. Moreover, since the damping material was prepared between the spring members of each flat spring, the special space for being applied and filled up with a damping material is not required, but a miniaturization can be attained. Moreover, the gap of the spring member of two upper and lower sides can be narrowed.

[0025] Drawing 8 is the modification of the gestalt of the 1st operation, and with the gestalt of the 1st operation, although the configuration of a driving means was the moving coil which fixed the coil to moving part, in this modification, it is considering as the MUBINGU magnet which prepared moving part the magnet. That is, like illustration, magnets 8 and 9 are fixed to a holder 1, and the magnetization opposes a unlike pole, forms a magnetic circuit, and makes flux density high. And it fixes to the base which is not illustrated, and the FUO dregs coil 3 is fixed to the surroundings of yokes 11 and 12, and yokes 11 and 12 fix the tracking coil 4 on winding and this FUO dregs coil 3, and are fixing the tilt coils 5 and 6 on it. About other configurations, it is the same as that of the gestalt of the 1st operation, and the same is said of an operation with each coil and a magnet. Thus, since magnets 8 and 9 are fixed to moving part 7, in case moving part 7 is made to drive, it is not necessary to supply electric power to moving part 7.

[0026] Drawing 9 shows the gestalt of operation of the 2nd of this invention. The same sign was given to the gestalt of the 1st operation, and the corresponding part (the same is said of the gestalt of the following operations). A drawing is the perspective diagram of moving part 7, and is winding four tilt coils around the corner section of a holder 1. If it sees about this tilt coil 22a, slanting side 22a-1 which faces a magnet 8 will rotate moving part 7 to the circumference of a Y-axis in the effective side. Since side 22a-2 of others and 22a-3 are separated from the magnet 8 to slanting side 22a-1, flux density is in a low location, and the force generated here can be disregarded. The same is said of other tilt coils 22b, 22c, and 22d. About an effect, it is the same as that of the gestalt of the 1st operation to other configurations and a pan.

[0027] Drawing 10 shows the modification of the gestalt of the 2nd operation. Although a drawing is the perspective diagram of moving part 7, the tilt coils 17 and 18 are wound around the circumference of the X-axis of a holder 1. And the slanting effective sides 17a, 17b, 18a, and 18b are located in the effective magnetic field of magnets 8 and 9. Since the other sides 17c, 17d, 18c, and 18d are distant from magnets 8 and 9 to the slanting sides 17a, 17b, 18a, and 18b, its flux density is low. Moreover, the other sides [17c 17d, 18c, and 18d] extension direction is perpendicular to the pole face of magnets 8 and 9. Therefore, the direction of the magnetic field which acts the other sides 17c, 17d, 18c, and 18d becomes almost parallel to the extension direction of these sides, and the force generated these sides can be disregarded. About an effect, it is the same as that of the gestalt of the 1st operation to other configurations and a pan.

[0028] Drawing 11 - drawing 15 show the gestalt of the 3rd operation. As shown in the perspective diagram of the driving gear of drawing 11 , the objective lens 2 has fixed in the hole of the center of a holder 1. Moreover, printed coils 23 and 24 have fixed in the direction side of Y of a holder 1. These printed coils 23 and 24 are three-tiered structures, sequentially from the direction near the magnets 8 and 9 which face each other, respectively, the TORATTO king coil 4 of two focal coil [3 or 1] and the tilt coil 5 (6) are formed, and the whole is hardened by resin, such as a rigid high epoxy resin. And moving part 7 consists of a holder 1, an objective lens 2, and printed coils 23 and 24.

[0029] Furthermore, the spring sheet 25 which etches the conductive high metallic foil of RYUMU copper etc. very, and changes has three springs 26 of the center which extends in the direction of Y, the three connection sections 27 which similarly extend in the direction of Y, and two connections 28 located in the direction both ends of Y. Thus, the constituted spring sheet 25 positions the direction end of Y(-) to slot 23a formed in the six direction both-sides sides of X of a printed coil 23 each, and soldering immobilization is carried out at the pattern of the copper formed around slot 23a. Moreover, the direction other end of Y(+) of the three connection sections 27 of the spring sheet 25 is positioned by slot 24a formed in the three direction both-sides sides of X of a printed coil 24 each, and adhesion immobilization is carried out. Moreover, the other end of three springs 26 of the spring sheet 25 is positioned and fixed to slot 10b-1 formed in the Y (+) side of the base 10. And it is soldered to the flexible substrate 29 fixed to the field by the side of holddown-member 10Y of b (+) fixed to the base 10. In addition, the other end of a spring 26 may be fixed to the flexible substrate 29 only with soldering. After such an

activity, the connection 28 of the spring sheet 25 is cut (A in drawing 12 and the B section are the cut section), and is divided into the connection section 27 of three springs [26 or 3].

[0030] It connects electrically in a total of six connection sections 27 between two printed coils 23 and 24 as mentioned above. That is, a total of six terminals of each two terminals of every of the focal coil 3 formed in the printed coil 24, the TORATTO king coil 4, and the tilt coil 6 are connected to a printed coil 23 by the connection section 27. Moreover, magnets 8 and 9 magnetized the two poles of the directions of X, fixed yokes 11 and 12 to the back, and have fixed the base to fixed part 10a of the base 10. Moreover, a unlike pole faces each other, and two magnets 8 and 9 are magnetized so that the flux density of a magnetic gap may be raised.

[0031] Next, a drive of moving part 7 is explained. If current is passed in the focal coil 3, the driving force of the direction of a focus will occur in cooperation with the magnetic field which magnets 8 and 9 generate, a total of six springs 26 of the spring sheet 25 will bend, and moving part 7 will be moved in the direction of a focus. Moreover, if current is passed in the TORATTO king coil 4, in cooperation with the magnetic field which magnets 8 and 9 generate, the driving force of the direction of a TORATTO king will occur, a total of six springs 26 will bend, and moving part 7 will be moved in the direction of tracking. Moreover, if current is passed in the tilt coil 5, the torque of the circumference of a Y-axis will occur in cooperation with the magnetic field which magnets 8 and 9 generate, a total of six springs 26 will bend, and moving part 7 will be rotated to the circumference of a Y-axis.

[0032] Next, an operation with a magnet and each coil is explained. Drawing 14 and drawing 15 show flux density distribution of a magnetic gap with a magnet. Among these, drawing 14 shows distribution of the direction of X of the Z direction center section of the magnetic gap, i.e., the flux density distribution of line P-P shown in drawing 13 (a), (the same is said of the magnetic field distribution). said -- it carried out -- as -- a magnet -- the direction of X -- 2 -- since it has magnetized very much, the direction of magnetic flux is reversed in the center like illustration, and there are two peaks. That is, the flux density of the part where 2 lists, and the both ends of a magnet and a magnetic field change [an effective magnetic field] in the direction of X is low. Moreover, drawing 15 shows distribution of the Z direction of the direction center section of X of the magnetic gap, i.e., the flux density distribution of line Q-Q shown in drawing 13 (a), (the same is said of the magnetic field distribution). According to this, flux density is low at the both ends of a magnet.

[0033] Next, the force generated in each coil according to drawing 13 is explained. It has stood in a line in the two directions of X, and, as for the focal coil 3, each faces the pole face where magnets 8 and 9 are magnetized two poles. And the Z direction center position of the surface 3a is the same as the Z direction center position of a magnet 8. Lower side 3c is located below the effective magnetic field range of a magnet 8 (2 each appearance of a magnet 8 magnetized very much).

[0034] Then, the force generated when current is passed in the focal coil 3 becomes like drawing 13 (a). And the effective force of a Z direction occurs in surface 3a located in an effective magnetic field midrange, and moving part 7 is moved in the direction of a focus. Since the sides 3b and 3d parallel to the Z-axis of the focal coil 3 are located in the periphery section of an effective magnetic field range at this time, the magnetic field which acts those sides is weak. Moreover, although the force as shown in drawing 13 (a) occurs the sides 3b and 3d, it will cancel with two focal coils of the direction of X. Moreover, since it is outside an effective magnetic field range, the force generated in lower side 3c of the focal coil 3 can disregard the force very weakly.

[0035] Furthermore, as for the tracking coil 4, the center position of the Z direction has become the same as the center position of the Z direction of a magnet 8. Moreover, the effective sides 4a and 4d parallel to the Z-axis of the tracking coil 4 are located in the center of an effective magnetic field in which two magnets 8 were magnetized. Then, if current is passed in the tracking coil 4, the sense of the current which flows the effective sides 4a and 4d as shown in drawing 13 (b) is reverse, and since the sense of a magnetic field is also reverse, the force will occur in the same direction of the direction of X. Moreover, although the force as shown in drawing 13 (b), respectively occurs in parallel to direction of X side 4b, and 4f, 4c and 4e, each will cancel.

[0036] Furthermore, as for the tilt coil 5, the center position of the Z direction of the surfaces 5a and 5b has become the same as the center position of the Z direction of a magnet 8. Moreover, the lower sides 5d and 5e are located below the effective magnetic field range of a magnet 8 (2 each appearance of a magnet 8 magnetized very much). Moreover, the sides 5c and 5f parallel to a Z direction are located in the periphery section of an effective magnetic field range. Then, if current is passed in the tilt coil 5, as shown in drawing 13 (c), the force of the reverse sense will occur in a Z direction in the surfaces 5a and 5b located in an effective magnetic field midrange, and the rotation drive of the moving part 7 will be carried out at the circumference of a Y-axis. And the center of gravity G of moving part 7, the support center S, and the nodal point NP of an objective lens are in agreement in the middle of Surfaces 5a and 5b. Therefore, even if it makes it rotate centering on the center of rotation of moving part 7, the spot of an objective lens does not move.

[0037] Moreover, since the sides 5c and 5f parallel to the Z-axis of the tilt coil 5 are located in the periphery section of an effective magnetic field range, they are weak. [of the magnetic field which acts around there] Therefore, the force generated the sides 5c and 5f is the degree which can be disregarded although it is the direction same in the direction of X. Moreover, since the lower sides 5d and 5e are located below the effective magnetic field range of a magnet 8, they are very weak. [of the force generated there] In addition, if the sides 5c and 5f are located outside the effective magnetic field range of a magnet 8, since a magnetic field becomes still weaker, it is much more effective. Moreover, although three kinds of coils were used as the printed coil, they may form each coil by winding and may paste it up on a holder. Moreover, it replaces with the magnet of 2 pole magnetization, and the sense of a magnetic pole may be made into reverse and two magnets may be combined.

[0038] Since the servo which was stabilized according to the gestalt of the 3rd operation, and a proper record regenerative

signal can be done like the above and also two sides parallel to the Z direction of a tracking coil are located in the direction of X in an effective magnetic field using the magnet magnetized two poles, the use effectiveness of a tracking coil becomes high and the drive sensitivity of the direction of tracking becomes high. Moreover, since electric connection between two the focal coils of a printed coil, tracking coils, and tilt coils is made by the spring and the connection section formed in one and he is trying to separate the connection section after that, the substrate which connects between coils becomes unnecessary. Moreover, since three springs and the three connection sections are united with the spring sheet using two connections, there are few components mark at the time of an assembly, and positioning is easy. Moreover, since there is no opening in which a yoke is located in a holder, the rigidity of a holder is high and can make resonance frequency high.

[0039] Drawing 16 shows the modification of the gestalt of the 3rd operation. This uses a focal coil also [drive / the object for a focal drive, and / tilt] not using a tilt coil. It is made for the force of the reverse sense to generate predetermined current in a Z direction in a sink focus coil at each of four focal coils 30a, 30b, 30c, and 30d. Then, moving part 7 receives the torque of the circumference of a Y-axis, and rotates to the circumference of a Y-axis. At this time, force like illustration arises in each focal coils [30a, 30b, 30c, and 30d] side. Three sides other than side 30a-1 which generates the effective force, 30b-1, and 30c-130d-1 are located in the periphery of an effective magnetic field range, or outside as the gestalt of the 3rd operation explained. Therefore, the force produced in these side 30a-2, 30a-3, 30a-4, 30b-2, 30b-3, 30b-4, 30c-2, 30c-3, 30c-4, 30d-2, 30d-3, and 30d-4 is small. Therefore, the force which moves the sink moving part 7 for it to them in the direction of X even if it leans current to the focal coils 30a, 30b, 30c, and 30d at the circumference of a Y-axis is very weak.

[0040] Moreover, if current is passed in each focal coil so that the force of the same direction may occur in a Z direction in four focal coils 30a, 30b, 30c, and 30d, moving part 7 is movable in the direction of a focus. Moreover, in each focal coil, it passes combining focus servo current and tilt servo current. Like the above, according to this modification, in addition to the effect of the gestalt of the 3rd operation, one kind of class of coil decreases, and simplification of a configuration can be attained.

[0041] This invention is not limited to the gestalt of the above operation, and can consider various modification and deformation. For example, in the gestalt of each operation, although NP of an objective lens is made in agreement focusing on the center of gravity of moving part, or support, if a center of gravity or a support center sets it as the degree located in the interior of an objective lens, the gap can make a minute amount extremely about 0-2mm and migration of the optical spot by the inclination of moving part since it is small. Moreover, although it constitutes so that moving part may be leaned to the circumference of a Y-axis, it may be made to lean to the circumference of the X-axis, and a tilt coil is prepared 2 sets and you may make it lean it to a 2-way. Moreover, although considered as the open magnetic circuit which it hits, and there is no yoke for which a magnetic circuit is formed, and which counters a magnet, and forms a magnetic gap only with a magnet, it is good also as a close magnetic circuit which arranges a yoke and forms a magnetic gap between this yoke so that a magnet may be countered. By carrying out like this, flux density becomes high and improvement in sensitivity can be aimed at. Moreover, although considered as the so-called moving coil drive which fixed the coil to moving part and arranged the magnet in the fixed part, it is good also as the so-called MUBINGU magnet drive which fixed the magnet to moving part and arranged the coil in the fixed part. Moreover, supporter material may be other members, such as a wire, and with [the number] two [or more], it is good by the number suitably. Moreover, a hologram is sufficient as an objective lens and the objective lens and the holder may really be formed. Moreover, the light source of laser etc. may be made to really form in moving part.

[0042] The contents indicated by the gestalt of the above operation can also be regarded as the following invention.

1. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means consists of a magnetic field generating means and a tilt coil. Said tilt coil The 1st portion which generates the rotation force of rotating said holder effective in the circumference of said shaft, It is the objective lens driving gear which consists of the other 2nd portion and is characterized by arranging said 1st portion in the location where the flux density within the magnetic field generated from said magnetic field generating means is higher than said 2nd portion.

[0043] 2. In Objective Lens Driving Gear Which Has Objective Lens, Holder Holding Said Objective Lens, and Driving Means for Rotating Said Holder to Circumference of Shaft Which Intersects Perpendicularly to Direction of Optical Axis of Said Objective Lens Said driving means is an objective lens driving gear characterized by resultant force of the force generated in the side which forms the tilt coil within the magnetic field which consists of a magnetic field generating means and a tilt coil, and is generated from said magnetic field generating means in said tilt coil constituting so that only the torque of a tilt may be generated.

[0044] 3. It is the objective lens driving gear which two or more arrangement of the 1st portion of said tilt coil is carried out into said magnetic field in the objective lens driving gear of the 1st publication, and is characterized by seeing from said shaft orientations and estranging rotation and said 1st portion of said holder.

[0045] 4. It is the objective lens driving gear characterized by being aslant arranged so that driving force may be generated at the 2-way of the direction where the direction of an optical axis of said objective lens and it, and the 1st portion of said tilt coil cross said holder at right angles in an objective lens driving gear given [said] in the 3rd term.

[0046] 5. It is the objective lens driving gear characterized by for the direction which the 1st portion of said tilt coil is in the field which intersects perpendicularly with said shaft, and intersects perpendicularly with the direction of an optical axis of said objective lens and it extending along a different direction in an objective lens driving gear given [said] in the 3rd term, and being arranged.

[0047] 6. It is the objective lens driving gear characterized by for the magnetic pole from which said magnetic field generating means differs adjoining mutually in an objective lens driving gear given [said] in the 1st term, forming it, and giving two different magnetic fields to the 1st portion of said tilt coil.
[0048] 7. It is the objective lens driving gear which said driving means has the focal coil and tracking coil for making said holder drive in the direction which intersects perpendicularly to the direction of an optical axis and this optical-axis direction of said objective lens further in an objective lens driving gear given in said the 1st thru/or 6th term, and is characterized by having arranged the 1st portion of said tilt coil in piles on said focal coil or a tracking coil.
[0049] 8. It is the objective lens driving gear which said magnet fixes to said holder in an objective lens driving gear given in said the 1st thru/or 7th term, and is characterized by arranging said tilt coil at a fixed part side.
[0050] 9. Objective lens driving gear characterized by having two or more elastic support members which support said holder elastically, and center between said two or more elastic support members and rotation center of said holder being in agreement in objective lens driving gear given in said the 1st thru/or 8th term.
[0051] 10. It is the objective lens driving gear characterized by the rotation center of said holder being in agreement with the nodal point of said objective lens in an objective lens driving gear given in said the 1st thru/or 9th term.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective diagram of the objective lens driving gear in which the gestalt of the 1st operation is shown.
[Drawing 2] It is the cross section of a flat spring.
[Drawing 3] It is explanatory drawing showing actuation of a flat spring.
[Drawing 4] It is the outline cross section cut at the center of an objective lens.
[Drawing 5] It is explanatory drawing showing the relation between a tilt coil and other coils.
[Drawing 6] It is explanatory drawing having shown the migration condition of moving part.
[Drawing 7] It is explanatory drawing showing the relation between a tilt coil and a magnet.
[Drawing 8] It is the perspective diagram of the moving part concerning the modification of the gestalt of the 1st operation.
[Drawing 9] It is the perspective diagram of the moving part which shows the gestalt of the 2nd operation.
[Drawing 10] It is the perspective diagram of the moving part concerning the modification of the gestalt of the 2nd operation.
[Drawing 11] It is the perspective diagram of the objective lens driving gear in which the gestalt of the 3rd operation is shown.
[Drawing 12] It is the decomposition perspective diagram of an objective lens driving gear.
[Drawing 13] It is explanatory drawing showing the force generated in each coil.
[Drawing 14] It is explanatory drawing showing flux density distribution.
[Drawing 15] It is explanatory drawing showing flux density distribution.
[Drawing 16] It is the perspective diagram of the moving part concerning the modification of the gestalt of the 3rd operation.
[Drawing 17] It is the objective lens driving gear of the conventional example.
[Drawing 18] It is explanatory drawing showing the force generated in the coil of the conventional example.
[Description of Notations]
5 Tilt Coil
6 Tilt Coil
8 Magnet

[Translation done.]

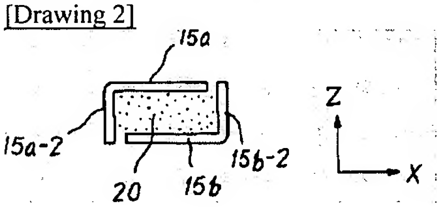
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective diagram of the objective lens driving gear in which the gestalt of the 1st operation is shown.
[Drawing 2] It is the cross section of a flat spring.
[Drawing 3] It is explanatory drawing showing actuation of a flat spring.
[Drawing 4] It is the outline cross section cut at the center of an objective lens.
[Drawing 5] It is explanatory drawing showing the relation between a tilt coil and other coils.
[Drawing 6] It is explanatory drawing having shown the migration condition of moving part.
[Drawing 7] It is explanatory drawing showing the relation between a tilt coil and a magnet.
[Drawing 8] It is the perspective diagram of the moving part concerning the modification of the gestalt of the 1st operation.
[Drawing 9] It is the perspective diagram of the moving part which shows the gestalt of the 2nd operation.
[Drawing 10] It is the perspective diagram of the moving part concerning the modification of the gestalt of the 2nd operation.
[Drawing 11] It is the perspective diagram of the objective lens driving gear in which the gestalt of the 3rd operation is shown.
[Drawing 12] It is the decomposition perspective diagram of an objective lens driving gear.
[Drawing 13] It is explanatory drawing showing the force generated in each coil.
[Drawing 14] It is explanatory drawing showing flux density distribution.
[Drawing 15] It is explanatory drawing showing flux density distribution.
[Drawing 16] It is the perspective diagram of the moving part concerning the modification of the gestalt of the 3rd operation.
[Drawing 17] It is the objective lens driving gear of the conventional example.
[Drawing 18] It is explanatory drawing showing the force generated in the coil of the conventional example.
[Description of Notations]
5 Tilt Coil
6 Tilt Coil
8 Magnet

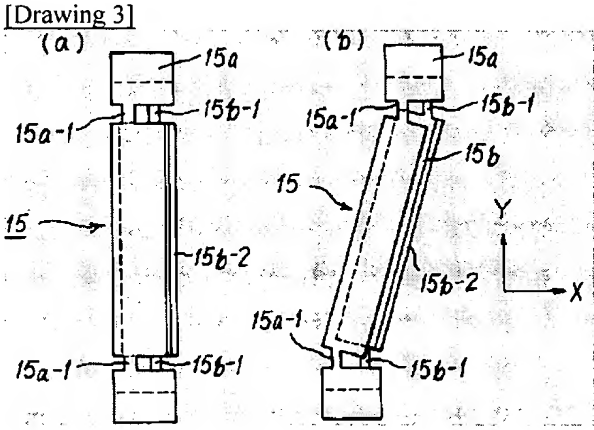
[Translation done.]

DRAWINGS

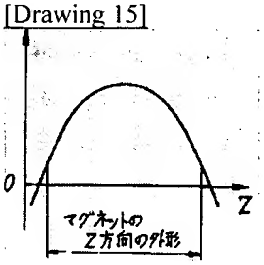
[Drawing 2]



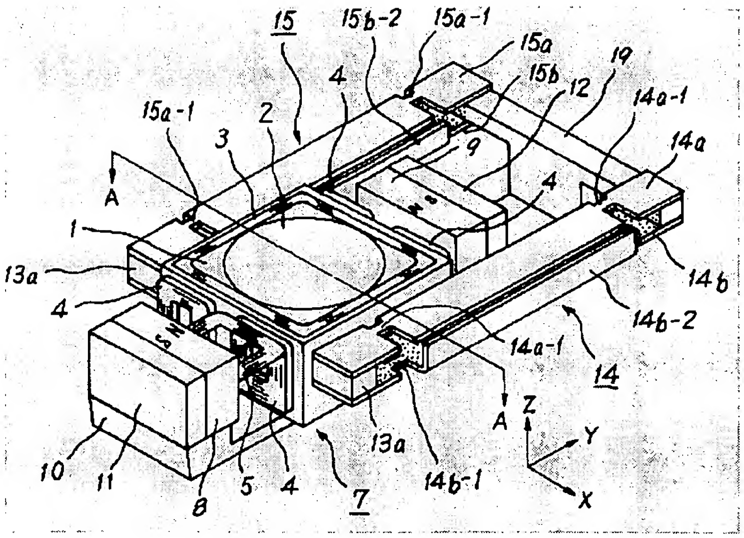
[Drawing 3]



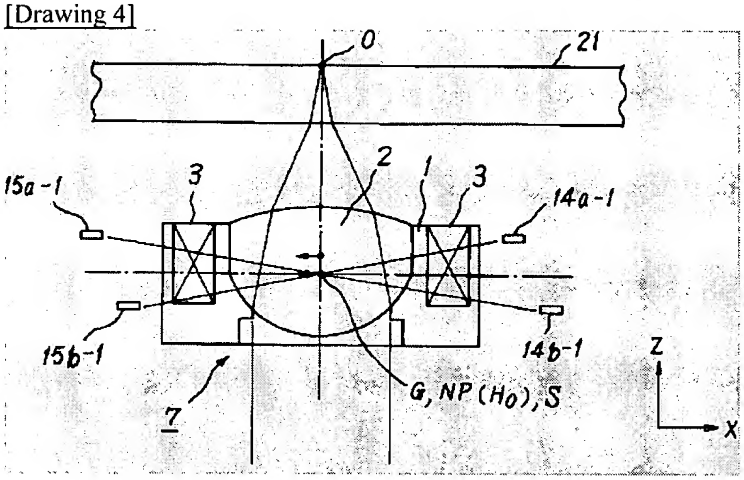
[Drawing 15]



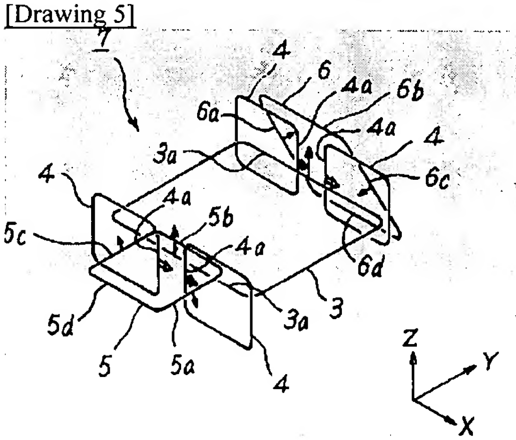
[Drawing 1]



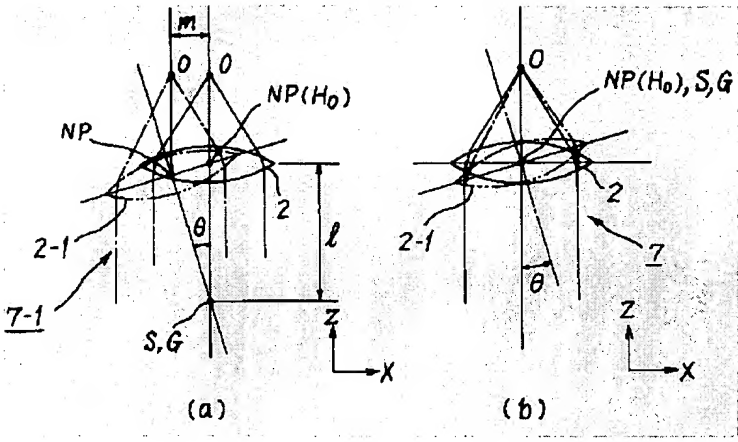
[Drawing 4]



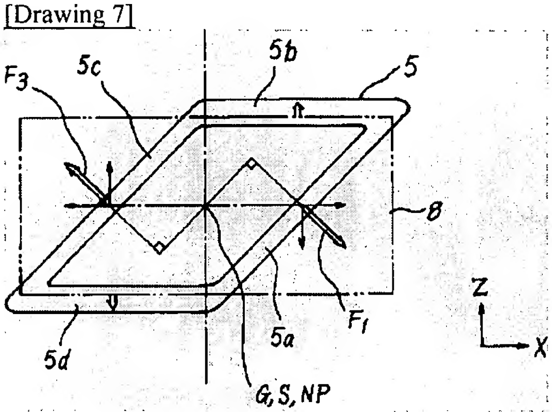
[Drawing 5]



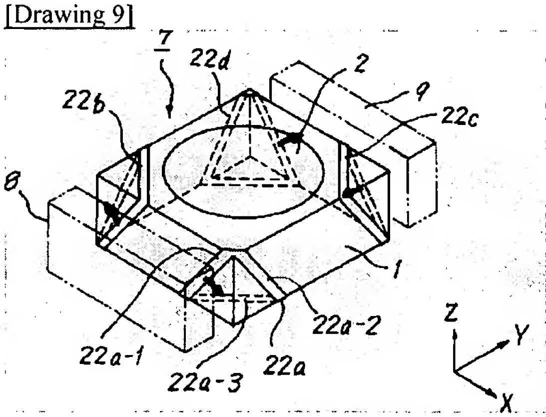
[Drawing 6]



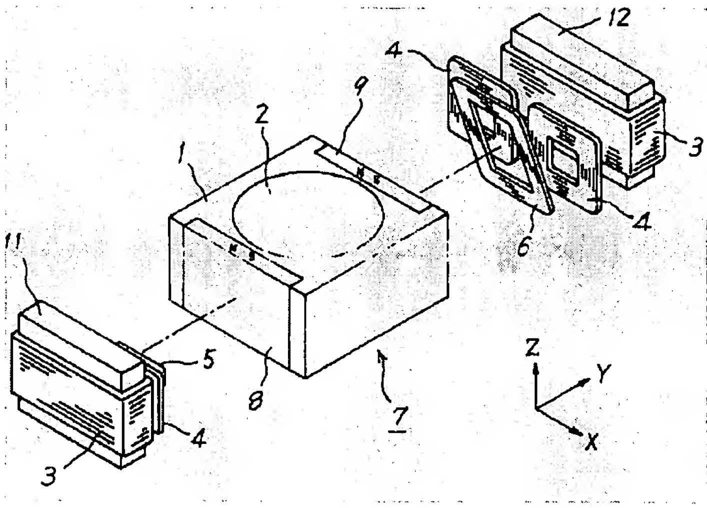
[Drawing 7]



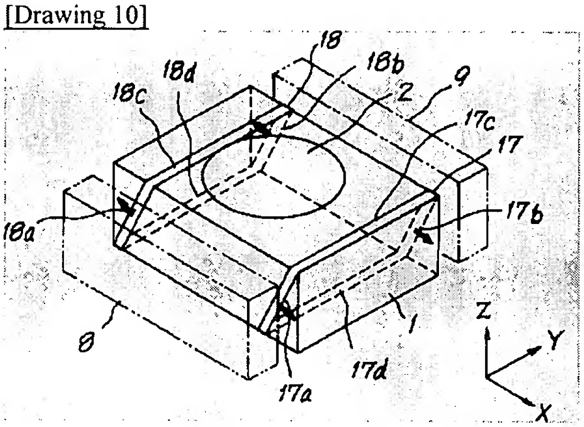
[Drawing 9]



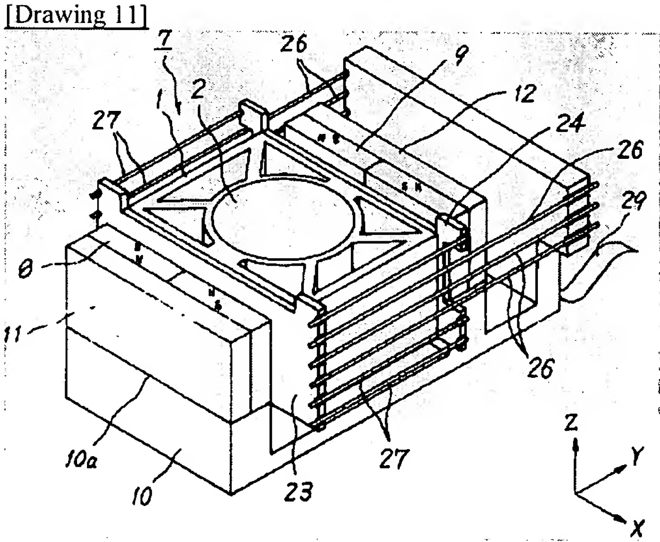
[Drawing 8]



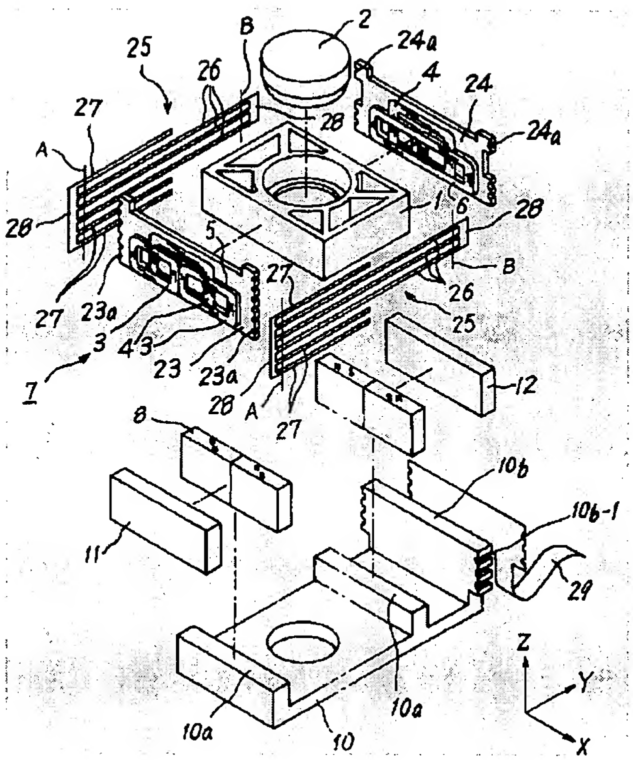
[Drawing 10]



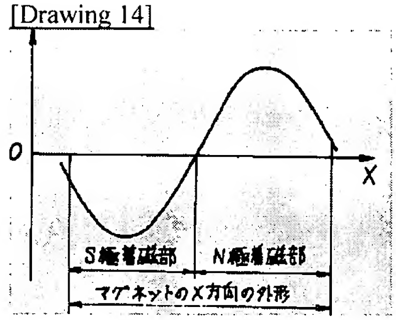
[Drawing 11]



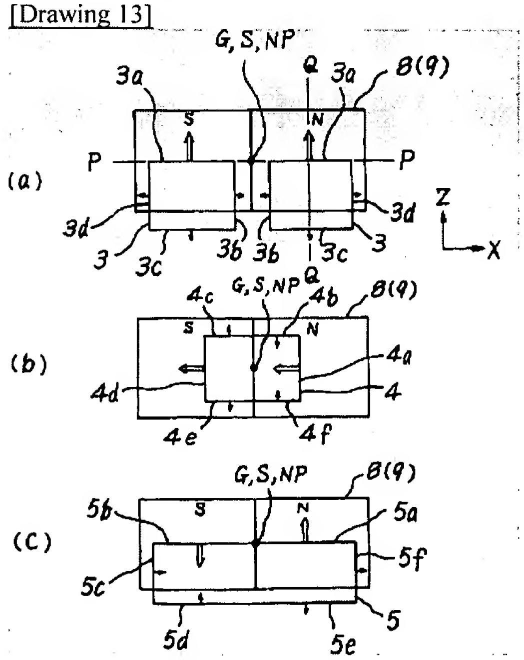
[Drawing 12]



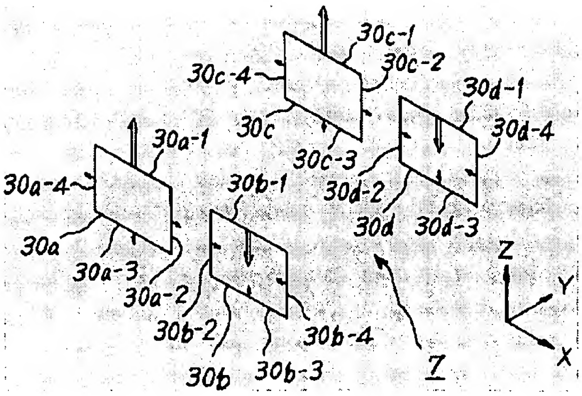
[Drawing 14]



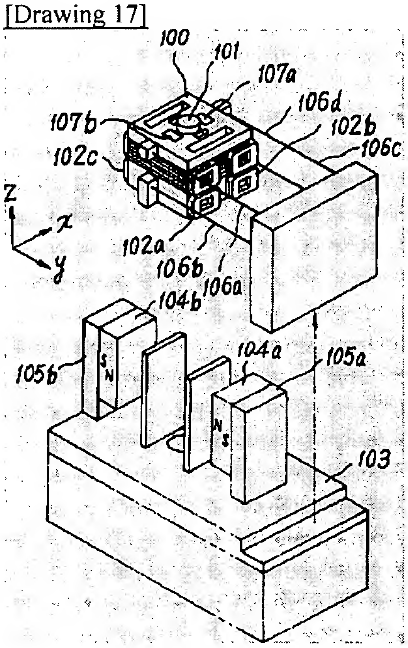
[Drawing 13]



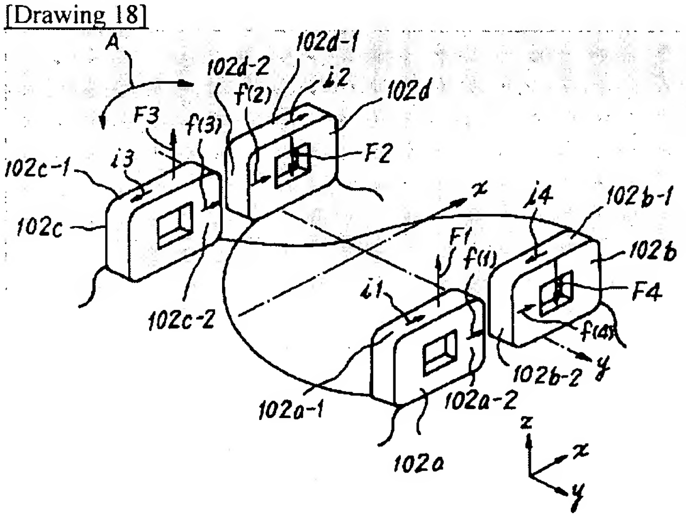
[Drawing 16]



[Drawing 17]



[Drawing 18]



[Translation done.]

PAT-NO: JP410116431A

DOCUMENT-IDENTIFIER: JP 10116431 A

TITLE: OBJECTIVE LENS DRIVING DEVICE

PUBN-DATE: May 6, 1998

INVENTOR-INFORMATION:
NAME
IKEGAME, TETSUO

ASSIGNEE-INFORMATION:

NAME	COUNTRY
OLYMPUS OPTICAL CO LTD	N/A

APPL-NO: JP08268659

APPL-DATE: October 9, 1996

INT-CL (IPC): G11B007/095

ABSTRACT:

PROBLEM TO BE SOLVED: To obtain an excellent servo characteristic by composing a tilt coil of a first part for generating turning force turning a holder around an axis crossing orthogonally the optical axial direction of an objective lens and another second part.

SOLUTION: In this objective lens driving device, sides excepting the effective sides of the tilt coils 5, 6 are placed on a position with low magnetic flux density of a magnetic gap peripheral part. Then, even when a current is allowed to flow through the tilt coils, the force moving a movable part 7 in the other direction such as the tracking direction, etc., doesn't occur. Thus, the disturbance doesn't increase in the tracking direction, focus direction and tangential direction, and a stable servo and a proper

recording/reproducing signal are realized. Further, the tilt coils are reduced so that only one is used for one side magnetic gap, and the constitution can be simplified, and the cost can be reduced.

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平10－116431

(43)公開日　平成10年(1998) 5月6日

(51)Int.Cl.⁶　識別記号　ＦＩ

Ｇ１１Ｂ　7/095　　Ｇ１１Ｂ　7/095　Ｄ

審査請求　未請求　請求項の数３　ＯＬ　（全 11 頁）

(21)出願番号　特願平8－268659

(22)出願日　平成８年(1996)10月９日

(71)出願人　000000376
オリンパス光学工業株式会社
東京都渋谷区幡ヶ谷２丁目43番２号

(72)発明者　池亀　哲夫
東京都渋谷区幡ヶ谷２丁目43番２号　オリンパス光学工業株式会社内

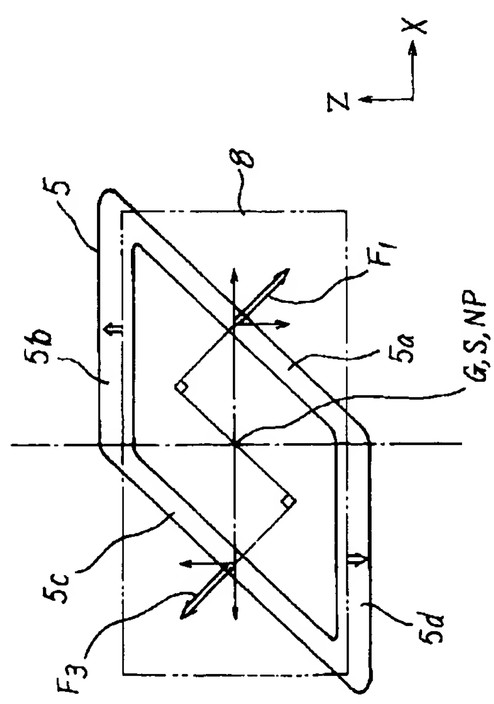
(74)代理人　弁理士　杉村　暁秀　（外３名）

(54)【発明の名称】　対物レンズ駆動装置

(57)【要約】

【課題】　対物レンズの傾き補正を行っても、対物レンズの光スポットが移動しないようにした対物レンズ駆動装置を提供すること。

【解決手段】　駆動手段を形成するチルトコイル５（６）のチルトに有効な力を発生する部分５ａ（６ａ），５ｃ（６ｃ）を、磁気ギャップ内に位置させ、それ以外の部分５ｂ（６ｂ），５ｄ（６ｄ）を、磁束密度の低い所に位置させ、対物レンズの傾き補正を行っても、適正な記録信号、再生信号を得られるようにしたもの。



1

【特許請求の範囲】

【請求項1】　対物レンズと、前記対物レンズを保持するホルダと、前記ホルダを前記対物レンズの光軸方向に対し直交する軸まわりに回動させるための駆動手段と、を有する対物レンズ駆動装置において、

前記駆動手段は、磁界発生手段とチルトコイルとからなり、前記チルトコイルは、前記ホルダを前記軸まわりに有効に回動させる回動力を発生させる第1の部分と、それ以外の第2の部分とからなり、前記第1の部分は前記第2の部分よりも前記磁界発生手段より発生される磁界内における磁束密度の高い位置に配置されることを特徴とする対物レンズ駆動装置。

【請求項2】　対物レンズと、前記対物レンズを保持するホルダと、前記ホルダを前記対物レンズの光軸方向に対し直交する軸まわりに回動させるための駆動手段と、を有する対物レンズ駆動装置において、

前記駆動手段は、磁界発生手段とチルトコイルとからなり、前記チルトコイルを、前記磁界発生手段より発生される磁界内のチルトコイルを形成する辺に発生する力の合力が、チルトのトルクのみを発生するように構成したことを特徴とする対物レンズ駆動装置。

【請求項3】　請求項1記載の対物レンズ駆動装置において、

前記チルトコイルの第1の部分は、前記磁界内に複数配置され、かつ、前記軸方向から見て前記ホルダの回動と前記第1の部分とが離間されることを特徴とする対物レンズ駆動装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、例えば、光磁気ディスクドライブ、追記型ディスクドライブ、相変化型ディスクドライブ、CD－ROM、DVD等の光記録媒体に対して、情報を少なくとも記録又は再生する情報記録再生装置に用いる対物レンズ駆動装置に関し、特に対物レンズの光軸の傾きを補正する対物レンズ駆動装置である。

【0002】

【従来の技術】光磁気ディスクドライブ、追記型ディスクドライブ、相変化型ディスクドライブ、CD－ROM、DVD等の光記録媒体に対して、情報を少なくとも記録又は再生する情報記録再生装置は、対物レンズを介して光記録媒体にビームスポットを照射して再生信号、記録信号を得るようになっている。この場合、対物レンズの光軸が光記録媒体の記録再生面に対して傾いていると光学的な収差が生じクロストークやジッターが増大し、再生信号が劣化することがある。また、記録時に記録信号が劣化し、ピット形成にミスを生じてしまうことがある。

【0003】この問題を解決するため、特開平7－65397号公報では以下のような対物レンズ駆動装置が提案されている。図17、図18に示すように、対物レンズホルダ100の上端に対物レンズ101を設け、対物レンズホルダ100の側面にチルトコイル102a～102dを取り付けている。また、基台103に、磁石104a，104bと、U字型ヨーク105a，105bと、対物レンズ101を傾動自在に支持する支持材106a～106dを取り付けている。対物レンズ101から照射されるビーム光軸と光ディスクの記録面との傾きは、径方向傾き検出器107a，107bとで検出される。

2

【0004】そして、傾き検出器107a，107bの誤差信号に基づき、チルトコイル102a～102dに通電し、対物レンズ101の光軸を高速で補正するようになっている。この場合、チルトコイル102a～102dに有効な力が発生するのは、各チルトコイル102a～102dの上側の辺102a－1，102b－1，102c－1，102d－1である。そして、径方向傾き（y軸周り）矢印Aの方向に傾ける時は、図18に示すように各チルトコイル102a～102dに矢印i1～i4方向に電流を流し、各チルトコイル102a～102dに矢印F1～F4の力を発生させ、対物レンズホルダ100及び対物レンズ101をy軸周りに傾ける。

【0005】

【発明が解決しようとする課題】しかしながら、図17に示す対物レンズ駆動装置は、各チルトコイル102a～102dの隣り合う辺102a－2，102b－2，102c－2，102d－2（図18）は、磁石104a，104bの中心寄りに位置し、その辺に作用する磁束密度は高い。したがって、辺102a－2，102b－2，102c－2，102d－2には、矢印f（1），f（2），f（3），f（4）の力が発生する（図18）。ところが、このf（1），f（2），f（3），f（4）の力は、全て同じ方向（x方向）であるため、対物レンズの傾き補正の際、対物レンズホルダ100及び対物レンズ101はy軸周りに傾くと同時にx方向に移動してしまう。そのため、トラッキング方向の外乱が増え、サーボの安定性が低くなるという不具合がある。

【0006】本発明は、前記不具合を解決すべく提案されるもので、対物レンズの傾き補正を行っても、対物レンズの光スポットが移動せず、適正な記録信号、再生信号を得られる対物レンズ駆動装置を提供することを目的としたものである。

【0007】

【課題を解決するための手段】

1．対物レンズと、前記対物レンズを保持するホルダと、前記ホルダを前記対物レンズの光軸方向に対し直交する軸まわりに回動させるための駆動手段と、を有する対物レンズ駆動装置において、前記駆動手段は、磁界発生手段とチルトコイルとからなり、前記チルトコイルは、前記ホルダを前記軸まわりに有効に回動させる回動

力を発生させる第１の部分と、それ以外の第２の部分とからなり、前記第１の部分は前記第２の部分よりも前記磁界発生手段より発生される磁界内における磁束密度の高い位置に配置される対物レンズ駆動装置とした。

【０００８】２．対物レンズと、前記対物レンズを保持するホルダと、前記ホルダを前記対物レンズの光軸方向に対し直交する軸まわりに回動させるための駆動手段と、を有する対物レンズ駆動装置において、前記駆動手段は、磁界発生手段とチルトコイルとからなり、前記チルトコイルを、前記磁界発生手段より発生される磁界内のチルトコイルを形成する辺に発生する力の合力が、チルトのトルクのみを発生するように構成した対物レンズ駆動装置とした。

【０００９】３．請求項１記載の対物レンズ駆動装置において、前記チルトコイルの第１の部分は、前記磁界内に複数配置され、かつ、前記軸方向から見て前記ホルダの回動と前記第１の部分とが離間される対物レンズ駆動装置とした。

【００１０】

【発明の実施の形態】以下、図面を参照しながら本発明の実施の形態を詳細に説明していく。図１～図7は、第１の実施の実施の形態を示したもので、光磁気ディスクを記録媒体とする情報記録再生装置の対物レンズ駆動装置を示している。なお、図中の座標軸のうち、X方向はトラッキング方向（記録トラックの法線方向、アクセス方向）を、Y方向はタンジェンシャル方向（記録トラックの接線方向）を、Z方向はフォーカシング方向（記録媒体面に垂直方向、対物レンズの光軸方向）を示している。

【００１１】図１に示すように、ホルダ１の中央に貫通孔が開けられそこに対物レンズ２を固着してある。ホルダ1のＺ（＋）側の対物レンズ２の周囲には溝が形成され、そこに四角状に巻回されたフォーカスコイル３が固着されている。ホルダ１のY方向両側には、巻回されたトラッキングコイル４が２個づつ計４個が、フォーカスコイル３の外側に固着されている。また、トラッキングコイル４の外側には、巻回された２個のチルトコイル５，６（図5）が固着されている。このチルトコイルは、図7に示すように並行四辺形形状を呈している。そして、前記ホルダ１、対物レンズ２、フォーカスコイル３、トラッキングコイル4、チルトコイル５，６とで可動部７を形成している。

【００１２】さらに、マグネット８，９が、チルトコイル5，６と対向するようにベース１０に配設固定され、マグネット８，９の背面にはヨーク１１，１２が固着され、磁束発生手段を形成している。なお、２つのマグネット８，9は、図１に示すように同極が向かい合うように着磁されている。また、フォーカスコイル3は、そのＺ方向の中心位置がマグネット８，９のＺ方向の中心位置と一致している。チルトコイル５，６は、その有効辺である斜めの辺５ａ，５ｃ，６ａ，６ｃ（第１の部分）がマグネット８，９と対向し、有効磁界中に位置している。なお、本実施の形態における有効磁界は、マグネット８，９に面する空間に発生している（図５）。また、チルトコイル５，６の他の辺、つまり上辺５ｂ，６ｂ及び下辺５ｄ，６ｄ（第２の部分）は、マグネット８，９の外周と同程度の位置、つまり磁束密度がマグネット８，９の中央部に比較してかなり低い所に位置している（図７）。つまり、チルトコイル５，６の斜め辺５ａ，５ｃ，６ａ，６ｃは、上辺５ｂ，６ｂ及び5ｄ，６ｄよりも磁束密度の高い所に位置している。

【００１３】さらに、ホルダ１のX方向両側に突起部１３ａが設けられ、この突起部１３ａのZ方向両側に後述するバネ１４，１５の一端が固定されている（図1）。このバネ１４，１５は、それぞれ２枚のバネ部材１４ａ，１４ｂと１５ａ，１５ｂを０．５～２ｍｍ程度の間隔を保持して上下に組み合わせてなる。また、Y方向両側近傍に細幅の撓み部１４ａ－１，１４ｂ－１，１５ａ－１，１５ｂ－1が形成され、それぞれの撓み部の間は幅方向（X方向）側部片側を直角に折り曲げた折り曲げ部１４ｂ－２，１５ｂ－２（図１において他の折り曲げ部は隠れている）が形成されている。なお、バネ１５（バネ１４についても同様）の上下に形成された撓み部１５ａ－１，１５ｂ－1は、図3に示すようにX方向にわずかにずらして形成されている。

【００１４】図2は、板バネ１５の断面図であるが、図示のように折り曲げ部１５ａ－２，１５ｂ－２が相互に対向するように組付けられ、略横長の長方形を呈している。そして、バネ部材１５ａと１５ｂで形成された空間の全域には、シリコーンゲル、シリコーングリス等のダンピング材２０が注入されている。また、図１に示すように板バネ１４，１５の他端は、ベース１０のY（＋）側に固定されている固定部材１９に固定されている。そして、対物レンズ２の移動に伴い板バネ１４，１５は、図3に示すように変形する。なお、図３（ａ）は変形前を示し、図３（ｂ）は変形後を示している。

【００１５】次に、対物レンズ２のＮＰ（ノーダルポイント）と、可動部７の重心G、支持中心Sとの関係を説明する。図4は、図１中の対物レンズ２の中心を、X－Z平面に平行なA－A面でカットし、それをY（－）側から見た概略断面図であるが対物レンズ２のＮＰと可動部７の重心Gは一致している。なお、対物レンズ2のＮＰと可動部７の重心Gは、X方向から見ても一致している。

【００１６】また、本実施の形態の対物レンズ2は、平行光を入射させてディスク２１上に集光させる無限光学系であるので、ＮＰは対物レンズ２の後ろ側（ディスク２１側）主点Hｏと一致している。さらに、可動部７を支持している４本の板バネの可動部７側の４つの撓み部１４ａ－１，１４ｂ－１，１５ａ－１，１５ｂ－1の中

点、すなわち支持中心Ｓも対物レンズ２のＮＰに一致させている。なお、支持中心Ｓとは、板バネ１４，１５の延在方向に平行な軸を想定し、その軸の周りに回転モーメントを可動部７に加えた際の可動部７の回動中心を示している。また、本実施の形態では、４本の板バネの剛性を同じにしたので、支持中心Ｓは４つの撓み部１４ａ－１，１４ｂ－１，１５ａ－１，１５ｂ－１の中点となり４本の板バネの剛性を部分的に変えると、支持中心Ｓは４つの撓み部１４ａ－１，１４ｂ－１，１５ａ－１，１５ｂ－１の中点からずれる。

【００１７】次に、可動部７の駆動力を図５により説明する。ここでは、各コイルを線図で表している。フォーカスコイル３に所定の電流を流すと、マグネットに対向した２辺３ａにフォーカス方向の力が発生し、可動部７をフォーカス方向に駆動させる。また４つのトラッキングコイル４に所定の電流を流すと、４つの内側の辺４ａにトラッキング方向の力が発生し、可動部７をトラッキング方向に駆動させる。

【００１８】次に、図7によりチルトコイル５について説明する。前記したように、チルトコイル５は平行四辺形を呈しており、その上辺５ｂと下辺５ｄ（第２の部分）はマグネット８の外形と同程度、斜めの辺５ａと５ｃ（第１の部分）はマグネット６のコーナーとX方向の中点を結ぶような辺となっている。そして、斜め辺５ａと５ｃは、Y方向から見て重心G、支持中心Ｓ、ノーダルポイントＮＰから離間されている。また、チルトコイル５の中点は、Y方向から見て重心G、支持中心Ｓ、ノーダルポイントＮＰ、マグネット８の中心（磁気ギャップの中心、磁束密度分布の中心）と一致している。なお、もう一方のチルトコイル６についても同様であると同時に、２つのチルトコイル５，６は図５に示すように斜めの辺が相互に逆向きとなるようになっている。

【００１９】そこでチルトコイル５に所定の電流を流すと、２つの斜めの辺５ａと５ｃに図７に示すような平行で逆向きの力F_1，F_3が発生する。この場合、チルトコイル５の中点がマグネット８の中心と一致しているので、力F_1，F_3の絶対値は等しい。そして、この力F_1，F_3は重心G（つまり支持中心Ｓ、ノーダルポイントＮＰ）に関してY軸周りのトルクを与え、可動部７を重心Gを中心としてY軸周り回動させる。なお、この力F_1，F_3は大きさが同じで平行で向きが逆なので、可動部７をX方向、Ｚ方向に移動させない。

【００２０】さらにF_1，F_3をＸ成分、Ｚ成分に分解してみると、Ｚ成分は可動部７を回動させ、X成分はX方向逆向きで同じ大きさであるのでキャンセルし合う。上辺５ｂと下辺５ｄには図７に示すような矢印方向の力が発生し、可動部７をY軸周りで前記と逆方向に回動させるトルクを発生させる。したがって、上辺５ｂと下辺５ｄに発生する力により可動部７をＸ、Ｙ、Ｚの各方向に移動させることはない。また、上辺５ｂと下辺５ｄはマグネット８の周辺部、つまり磁気ギャップの周辺部で磁束密度の非常に弱い所に位置しているので、その力は弱く無視できる程度のものである。なお、チルトコイル６に所定の電流を流した場合も、前記したチルトコイル５の場合と同様な作用により可動部７をX、Y、Ｚの各方向に移動させることはない。したがって、チルトコイル５，６に電流を流して可動部７を回動させても、X、Y、Ｚの各方向に移動させることはない。

【００２１】さらに、可動部７をY軸周りに回動駆動させる場合、Y軸周りの共振周波数より低い周波数では、可動部７はほぼ支持中心Ｓを中心として回転する。一方、Y軸周りの共振周波数より高い周波数では、可動部７はほぼその重心Gを中心として回動する。そして、本実施の形態では、対物レンズ２のＮＰ、可動部７の重心G、支持中心Ｓを一致させているので、可動部７をY軸周りに回動させても対物レンズ２のスポット位置はずれない。以下、図６を参照しながら一層詳細に説明する。なお、図６（ａ）は、可動部の重心Gと対物レンズのＮＰがずれた従来の状態を示したもので、図６（ｂ）は、本実施例の状態を示したものである。

【００２２】図６（ａ）では、可動部７－１が自身の重心Gを中心としてY軸周りにθ回動した場合、対物レンズ２のＮＰはX方向にmだけ移動する（２－１）。つまり、可動部７－１の重心Gから対物レンズ２のＮＰの距離をｌとすると、スポットOの移動量mは、

$$m = l \cdot \theta$$

となる。これに対して本実施例の図６（ｂ）では可動部７の重心Gと対物レンズ２のＮＰを一致させているので、可動部７が傾いて対物レンズ２が傾いたとしても、可動部７はＮＰを中心に回動することになる。したがって、ｌ＝０となり、

$$m = l \cdot \theta = 0$$

となり、スポットOは対物レンズ２が傾いたとしても、X方向にずれない。したがって、対物レンズ２Y軸周りに傾けてもトラッキング方向の外乱とならない。また、可動部７が支持中心Ｓを中心に回転しても、同様にスポットOは対物レンズ２が傾いたとしても、X方向にずれない。このように、本実施の形態では、可動部７を傾けてもスポットが移動することはない。

【００２３】以上のごとく、第１の実施の形態によれば、チルトコイル５，６の有効辺以外の辺を磁気ギャップ周辺部の磁束密度の低い所に位置させたので、チルトコイルに電流を流しても、可動部７をトラッキング方向等の他の方向に移動させる力が発生しない。したがって、トラッキング方向、フォーカス方向、タンジェンシャル方向に外乱が増えず、安定したサーボ、適正な記録再生信号を実現できる。また、チルトコイルは片側の磁気ギャップに１つと少なくてよく、構成の簡索化、低コストを実現できる。

【００２４】また、ホルダ１に固着するフォーカスコイ

ル3及びトラッキングコイル4のそれぞれの重心を対物レンズ2のNPと一致させるように配設し、さらにホルダ1を支持する板バネ14，15の固着部位たる一端を対物レンズ2のNPに近づけるように配設したので、対物レンズ2のNPと可動部7の重心Gとを容易に一致させることができるとともに、重心位置調整用のバランサを必要としないので、可動部7の小型、軽量化を実現できる。また、それぞれの板バネのバネ部材の間にダンピング材を設けたので、ダンピング材を塗布、充填するための特別のスペースを要せず、小型化を図れる。また、上下2枚のバネ部材の間隔を狭くできる。

【0025】図8は、第1の実施の形態の変形例であり、第1の実施の形態では駆動手段の構成は可動部にコイルを固着したムービングコイルであったが、この変形例では可動部にマグネットを設けたムービングマグネットとしている。つまり、図示のように、ホルダ1にマグネット8，9を固定し、その着磁は異極を向かい合わせて磁気回路を形成し磁束密度を高くしている。そして、ヨーク11，12は図示していないベースに固定し、ヨーク11，12の周りにフーォカスコイル3を巻回し、このフーォカスコイル3の上にトラッキングコイル4を固定し、その上にチルトコイル5，6を固定している。他の構成については、第1の実施の形態と同様であり、各コイルとマグネットとの作用についても同様である。このように可動部7にマグネット8，9を固定しているので、可動部7を駆動させる際、可動部7に給電しなくてもよい。

【0026】図9は、本発明の第2の実施の形態を示したものである。第1の実施の形態と対応する箇所には同一符号を付した（以下の実施の形態についても同様）。図面は可動部7の斜視図であり、ホルダ1のコーナー部に4つのチルトコイルを巻いている。このチルトコイル22aについて見ると、マグネット8に向かい合う斜め辺22a－1が有効辺で可動部7をY軸周りに回動させる。その他の辺22a－2，22a－3は、斜め辺22a－1に対してマグネット8から離れているので磁束密度が低い位置にあり、ここに発生する力は無視できる。他のチルトコイル22b，22c，22dについても同様である。他の構成、さらに効果については第1の実施の形態と同様である。

【0027】図10は第2の実施の形態の変形例を示したものである。図面は可動部7の斜視図であるが、チルトコイル17，18はホルダ1のX軸周りに巻かれている。そして、マグネット8，9の有効磁界中に斜めの有効辺17a，17b，18a，18bが位置している。その他の辺17c，17d，18c，18dは、斜めの辺17a，17b，18a，18bに対して、マグネット8，9から離れているので磁束密度が低い。また、その他の辺17c，17d，18c，18dの延在方向は、マグネット8，9の磁極面に垂直方向である。したがって、その他の辺17c，17d，18c，18dに作用する磁界の方向は、これらの辺の延在方向にほぼ平行となり、これらの辺に発生する力は無視できる。他の構成、さらに効果については第1の実施の形態と同様である。

【0028】図11～図15は、第3の実施の形態を示したものである。図11の駆動装置の斜視図に示すように、ホルダ1の中央の穴に対物レンズ2が固着されている。また、ホルダ1のY方向側面にはプリントコイル23，24が固着されている。このプリントコイル23，24は3層構造で、それぞれ向かい合うマグネット8，9に近い方から順に、2つのフォーカスコイル3、1つのトラットキングコイル4、チルトコイル5（6）が形成され、全体は剛性の高いエポキシ樹脂等の樹脂で固められている。そして、ホルダ1、対物レンズ2、プリントコイル23，24で可動部7が構成されている。

【0029】さらに、ベリリューム銅等の導電性の高い金属箔をエッチングして成るバネシート25が、Y方向に延在する中央の3本のバネ26、同じくY方向に延在する3本の連結部27、Y方向両端に位置する2つの接続部28を有している。このように構成されたバネシート25は、Y（－）方向一端をプリントコイル23のX方向両側面に各6個形成された溝23aに位置決めし、溝23a周辺に形成された銅のパターンに半田付け固定される。また、バネシート25の3本の連結部27のY（＋）方向他端は、プリントコイル24のX方向両側面に各3個形成された溝24aに位置決めされ接着固定される。また、バネシート25の3本のバネ26の他端はベース10のY（＋）側に形成された溝10b－1に位置決めされ、固定される。そして、ベース10に固定された固定部材10bのY（＋）側の面に固定されたフレキシブル基板29に半田付けされる。なお、バネ26の他端はフレキシブル基板29に半田付けのみで固定してもよい。こうした作業後、バネシート25の接続部28はカットされ（図12におけるA，B部がカット部）3本のバネ26、3本の連結部27に分離される。

【0030】以上のようにして、2つのプリントコイル23，24の間は、計6本の連結部27で電気的に接続される。つまり、プリントコイル24に形成されたフォーカスコイル3、トラットキングコイル4、チルトコイル6の各端末2本づつの計6本の端末が、連結部27によりプリントコイル23に接続されるのである。また、マグネット8，9はX方向を2極着磁し、背面にヨーク11，12を固定し、底面をベース10の固定部10aに固着されている。また、2つのマグネット8，9は異極が向かい合い、磁気ギャップの磁束密度を高めるように着磁されている。

【0031】次に可動部7の駆動について説明する。フォーカスコイル3に電流を流すと、マグネット8，9の発生する磁界と協同しフォーカス方向の駆動力が発生

し、バネシート２５の計６本のバネ２６が撓み、可動部７をフォーカス方向に移動させる。また、トラットキングコイル４に電流を流すと、マグネット８，９の発生する磁界と協同しトラットキング方向の駆動力が発生し、計６本のバネ２６が撓み可動部７をトラッキング方向に移動させる。また、チルトコイル５に電流を流すと、マグネット８，９の発生する磁界と協同しＹ軸周りのトルクが発生し、計６本のバネ２６が撓み可動部７をＹ軸周りに回動させる。

【００３２】次に、マグネットと各コイルとの作用について説明する。図１４、図１５は、マグネットによる磁気ギャップの磁束密度分布を示している。このうち、図１４は磁気ギャップのＺ方向中央部のＸ方向の分布、つまり図１３（ａ）に示す線Ｐ－Ｐの磁束密度分布（磁界分布も同じ）を示している。前記したようにマグネットはＸ方向に２極着磁してあるので、図示のように磁束の方向が中央で逆転しピークが２つある。つまり、有効磁界がＸ方向に２つ並び、マグネットの両端部と磁界の切り替わる箇所の磁束密度が低くなっている。また、図１５は磁気ギャップのＸ方向中央部のＺ方向の分布、つまり図１３（ａ）に示す線Ｑ－Ｑの磁束密度分布（磁界分布も同じ）を示している。これによるとマグネットの両端部で磁束密度が低くなっている。

【００３３】次に、図１３に従い各コイルに発生する力について説明する。フォーカスコイル３は、Ｘ方向に２つ並んでおり、それぞれがマグネット８，９の２極着磁されている磁極面に向かい合っている。そして、その上辺３ａのＺ方向中心位置がマグネット８のＺ方向中心位置と同じになっている。下辺３ｃは、マグネット８の有効磁界範囲（マグネット８の２極着磁されたそれぞれの外形）よりも下に位置している。

【００３４】そこで、フォーカスコイル３に電流を流したとき発生する力は、図１３（ａ）のようになる。そして、有効磁界範囲の中央に位置する上辺３ａにＺ方向の有効な力が発生し可動部７をフォーカス方向に移動させる。この時、フォーカスコイル３のＺ軸に平行な辺３ｂ，３ｄは、有効磁界範囲の外周部に位置しているので、それらの辺に作用する磁界は弱い。また、辺３ｂ，３ｄには、図１３（ａ）に示すような力が発生するが、Ｘ方向の２つのフォーカスコイルでキャンセルしてしまう。また、フォーカスコイル３の下辺３ｃに発生する力は、有効磁界範囲の外なので力はごく弱く無視できる。

【００３５】さらに、トラッキングコイル４は、そのＺ方向の中心位置がマグネット８のＺ方向の中心位置と同じになっている。また、トラッキングコイル４のＺ軸に平行な有効辺４ａ，４ｄは、２つのマグネット８の着磁された有効磁界の中央に位置する。そこで、トラッキングコイル４に電流を流すと、図１３（ｂ）に示すように有効辺４ａ，４ｄに流れる電流の向きは逆で磁界の向きも逆なので、Ｘ方向の同じ向きに力が発生する。また、Ｘ方向に平行な辺４ｂと４ｆ、４ｃと４ｅにはそれぞれ図１３（ｂ）に示すような力が発生するが、それぞれがキャンセルしてしまう。

【００３６】さらに、チルトコイル５は、その上辺５ａ、５ｂのＺ方向の中心位置がマグネット８のＺ方向の中心位置と同じになっている。また、下辺５ｄ，５ｅは、マグネット８の有効磁界範囲（マグネット８の２極着磁されたそれぞれの外形）よりも下に位置する。また、Ｚ方向に平行な辺５ｃ，５ｆは有効磁界範囲の外周部に位置する。そこで、チルトコイル５に電流を流すと、図１３（ｃ）に示すように有効磁界範囲の中央に位置する上辺５ａ、５ｂにＺ方向で逆向きの力が発生し、可動部７をＹ軸周りに回転駆動させる。そして、上辺５ａ、５ｂの中間に可動部７の重心Ｇ、支持中心Ｓ、対物レンズのノーダルポイントＮＰが一致している。したがって、可動部７の回転中心を中心に回動させても対物レンズのスポットは移動しない。

【００３７】また、チルトコイル５のＺ軸に平行な辺５ｃ，５ｆは、有効磁界範囲の外周部に位置しているので、その辺に作用する磁界は弱い。したがって、辺５ｃ，５ｆに発生する力はＸ方向で同じ方向であるが無視できる程度のものである。また、下辺５ｄ，５ｅは、マグネット８の有効磁界範囲よりも下に位置しているので、そこに発生する力は極めて弱い。なお、辺５ｃ，５ｆをマグネット８の有効磁界範囲よりも外側に位置させれば磁界はさらに弱くなるので一層効果的である。また、３種類のコイルはプリントコイルとしたが、巻き線により各コイルを形成し、ホルダに接着してもよい。また、２極着磁のマグネットに代えて、２個のマグネットを磁極の向きを逆にして組み合わせてもよい。

【００３８】以上のごとく第３の実施の形態によれば、安定したサーボ、適正な記録再生信号ができる他、Ｘ方向に２極着磁したマグネットを用い、トラッキングコイルのＺ方向に平行な２辺を有効磁界中に位置させているので、トラッキングコイルの利用効率が高くなりトラッキング方向の駆動感度が高くなる。また、２つのプリントコイルのフォーカスコイル、トラッキングコイル、チルトコイル間の電気的な接続を、バネと一体的に形成した連結部により行い、その後、連結部を分離するようにしているので、コイル間を連結する基板が不要となる。また、３本のバネ、３本の連結部を２つの接続部を用いてバネシートに一体化してあるため、組み立て時の部品点数が少なく位置決めが容易である。また、ホルダにヨークが位置する開口部が無いので、ホルダの剛性が高く、共振周波数を高くできる。

【００３９】図１６は、第３の実施の形態の変形例を示したものである。これは、チルトコイルを用いず、フォーカスコイルをフォーカス駆動用とチルト駆動用とに兼用したものである。４つのフォーカスコイル３０ａ，３０ｂ，３０ｃ，３０ｄの各々に所定の電流を流しフォー

カスコイルにZ方向で逆向きの力が発生するようにする。すると、可動部7は、Y軸周りのトルクを受けY軸周りに回動する。この時、フォーカスコイル30a，30b，30c，30dの各辺には図示のような力が生じる。有効な力を発生する辺30a－1，30b－1，30c－130d－1以外の3辺は、第3の実施の形態で説明したように、有効磁界範囲の周辺部または外に位置する。したがって、これらの辺30a－2，30a－3，30a－4，30b－2，30b－3，30b－4，30c－2，30c－3，30c－4，30d－2，30d－3，30d－4に生じる力は小さい。したがって、フォーカスコイル30a，30b，30c，30dに電流を流し可動部7をY軸周りに傾けてもX方向に移動する力は極めて弱い。

【0040】また、4つのフォーカスコイル30a，30b，30c，30dにZ方向で同じ向きの力が発生するように各フォーカスコイルに電流を流すと、可動部7をフォーカス方向に移動することができる。また、各フォーカスコイルには、フォーカスサーボ電流とチルトサーボ電流を組み合わせて流す。以上のごとく、この変形例によれば、第3の実施の形態の効果に加えコイルの種類が1種類少なくなり構成の簡素化を図れる。

【0041】本発明は、以上の実施の形態に限定されるものではなく、種々の変更、変形が考えられる。例えば、各実施の形態において、対物レンズのNPを可動部の重心または支持中心に一致させているが、重心または支持中心が対物レンズの内部に位置する程度に設定すれば、そのずれは0～2mm程度と小さいので、可動部の傾きによる光スポットの移動を極めて微小量にすることができる。また、可動部をY軸周りに傾けるように構成しているが、X軸周りに傾けるようにしてもよいし、チルトコイルを2組設け2方向に傾けるようにしてもよい。また、磁気回路を形成するあたり、マグネットに対向するヨークが無くマグネットのみで磁気ギャップを形成する開磁気回路としているが、マグネットに対向するようにヨークを配設してこのヨークとの間で磁気ギャップを形成する閉磁気回路としてもよい。こうすることにより、磁束密度が高くなり感度の向上を図れる。また、可動部にコイルを固定しマグネットを固定部に配設したいわゆるムービングコイル駆動としているが、マグネットを可動部に固定し、コイルを固定部に配設したいわゆるムービングマグネット駆動としてもよい。また、支持部材はワイヤ等他の部材であってもよいし、その数は2つ以上であれば適宜数でよい。また、対物レンズはホログラムでもよいし、対物レンズとホルダは一体形成されていてもよい。また、可動部にレーザ等の光源を一体形成させてもよい。

【0042】以上の実施の形態に記載された内容は以下の発明として捉えることもできる。

1．対物レンズと、前記対物レンズを保持するホルダと、前記ホルダを前記対物レンズの光軸方向に対し直交する軸まわりに回動させるための駆動手段と、を有する対物レンズ駆動装置において、前記駆動手段は、磁界発生手段とチルトコイルとからなり、前記チルトコイルは、前記ホルダを前記軸まわりに有効に回動させる回動力を発生させる第1の部分と、それ以外の第2の部分とからなり、前記第1の部分は前記第2の部分よりも前記磁界発生手段より発生される磁界内における磁束密度の高い位置に配置されることを特徴とする対物レンズ駆動装置。

【0043】2．対物レンズと、前記対物レンズを保持するホルダと、前記ホルダを前記対物レンズの光軸方向に対し直交する軸まわりに回動させるための駆動手段と、を有する対物レンズ駆動装置において、前記駆動手段は、磁界発生手段とチルトコイルとからなり、前記チルトコイルを、前記磁界発生手段より発生される磁界内のチルトコイルを形成する辺に発生する力の合力が、チルトのトルクのみを発生するように構成したことを特徴とする対物レンズ駆動装置。

【0044】3．第1記載の対物レンズ駆動装置において、前記チルトコイルの第1の部分は、前記磁界内に複数配置され、かつ、前記軸方向から見て前記ホルダの回動と前記第1の部分とが離間されることを特徴とする対物レンズ駆動装置。

【0045】4．前記第3項記載の対物レンズ駆動装置において、前記チルトコイルの第1の部分は、前記ホルダを前記対物レンズの光軸方向およびそれと直交する方向の2方向に駆動力が発生されるように斜めに配置されることを特徴とする対物レンズ駆動装置。

【0046】5．前記第3項記載の対物レンズ駆動装置において、前記チルトコイルの第1の部分は前記軸と直交する面内で、かつ、前記対物レンズの光軸方向およびそれと直交する方向とは異なる方向に沿って延在して配置されることを特徴とする対物レンズ駆動装置。

【0047】6．前記第1項記載の対物レンズ駆動装置において、前記磁界発生手段は異なる磁極が互いに隣接して形成され、前記チルトコイルの第1の部分に対して2つの異なる磁界を与えることを特徴とする対物レンズ駆動装置。

【0048】7．前記第1乃至第6項に記載の対物レンズ駆動装置において、前記駆動手段は、更に、前記ホルダを前記対物レンズの光軸方向および該光軸方向に対し直交する方向に駆動させるためのフォーカスコイルおよびトラッキングコイルを有し、前記チルトコイルの第1の部分は、前記フォーカスコイルまたはトラッキングコイル上に重ねて配置したことを特徴とする対物レンズ駆動装置。

【0049】8．前記第1乃至第7項に記載の対物レンズ駆動装置において、前記マグネットは前記ホルダに固着され、前記チルトコイルは固定部側に配置されること

を特徴とする対物レンズ駆動装置。

【００５０】９．前記第１乃至第８項に記載の対物レンズ駆動装置において、前記ホルダを弾性的に支持する複数の弾性支持部材を有し、前記複数の弾性支持部材間の中心と前記ホルダの回動中心とが一致されていることを特徴とする対物レンズ駆動装置。

【００５１】１０．前記第１乃至第９項に記載の対物レンズ駆動装置において、前記ホルダの回動中心は前記対物レンズのノーダルポイントに一致していることを特徴とする対物レンズ駆動装置。

【００５２】

【発明の効果】以上説明したように、本発明によれば以下の効果を奏する。請求項１の対物レンズ駆動装置によれば、チルトコイルのホルダを有効に回動させる回動力を発生させる第１の部分をそれ以外の第２部分よりも磁界発生手段より発生される磁界内における磁束度の高い位置に配置させたことにより、チルトコイルに可動部を回動させる力以外の力が発生しないか、発生しても極めて小さい。したがって、可動部が回動以外の移動をしないか極わずかしか移動しないので、対物レンズの傾き補正を行っても対物レンズのスポットが移動せず、トラッキング方向等に大きな外乱が発生せず、良好なサーボ特性、適正な記録再生信号が得られるようになる。

【００５３】請求項２の対物レンズ駆動装置によれば、チルトコイルを、前記磁界発生手段が発生する磁気ギャップ内のチルトコイルを形成する辺に発生する力の合力が、チルトのトルクのみを発生するように構成しているので、チルトコイルに可動部を回動させる力以外の力が発生しないか、発生しても極めて小さい。したがって、可動部が回動以外の移動をしないか極わずかしか移動しないので、対物レンズの傾き補正を行っても対物レンズのスポットが移動せず、トラッキング方向等に大きな外乱が発生せず、良好なサーボ特性、適正な記録再生信号が得られるようになる。

【図面の簡単な説明】

【図１】第１の実施の形態を示す対物レンズ駆動装置の斜視図である。

【図２】板バネの断面図である。

【図３】板バネの動作を示す説明図である。

【図４】対物レンズの中心でカットした概略断面図である。

【図５】チルトコイルと他のコイルとの関係を示す説明図である。

【図６】可動部の移動状態を示した説明図である。

【図７】チルトコイルとマグネットの関係を示す説明図である。

【図８】第１の実施の形態の変形例に係る可動部の斜視図である。

【図９】第２の実施の形態を示す可動部の斜視図である。

【図１０】第２の実施の形態の変形例に係る可動部の斜視図である。

【図１１】第３の実施の形態を示す対物レンズ駆動装置の斜視図である。

【図１２】対物レンズ駆動装置の分解斜視図である。

【図１３】各コイルに発生する力を示す説明図である。

【図１４】磁束密度分布を示す説明図である。

【図１５】磁束密度分布を示す説明図である。

【図１６】第３の実施の形態の変形例に係る可動部の斜視図である。

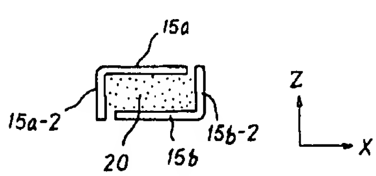
【図１７】従来例の対物レンズ駆動装置である。

【図１８】従来例のコイルに発生する力を示す説明図である。

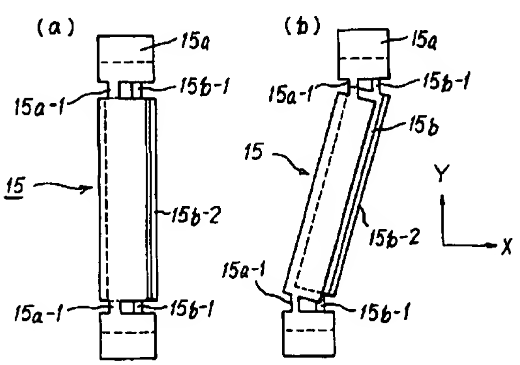
【符号の説明】

５　チルトコイル
６　チルトコイル
８　マグネット

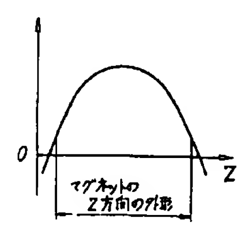
【図２】



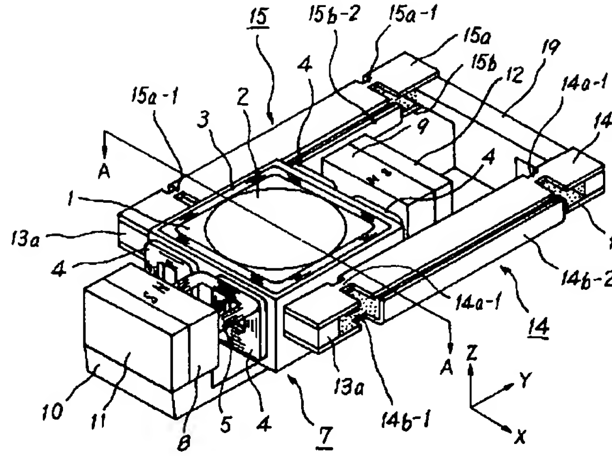
【図３】



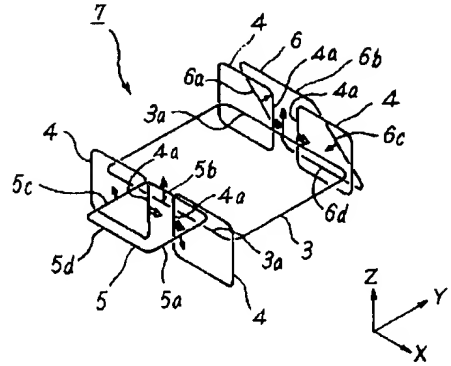
【図１５】



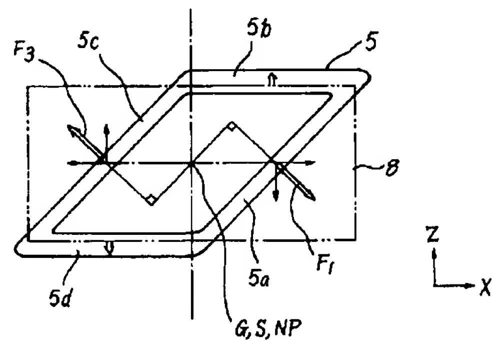
【図１】



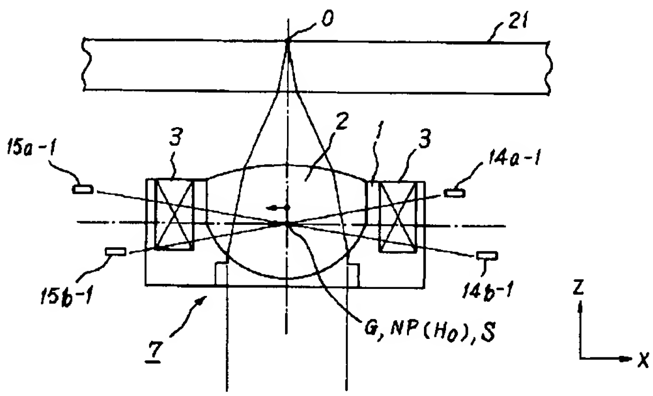
【図５】



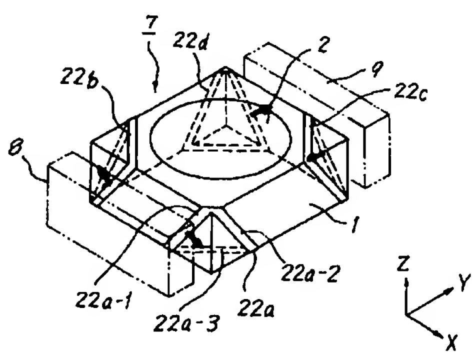
【図７】



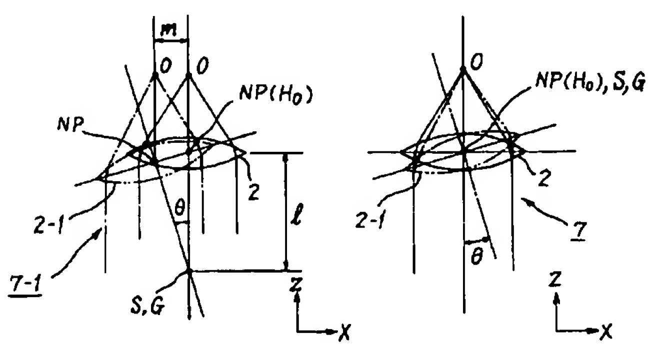
【図４】



【図９】

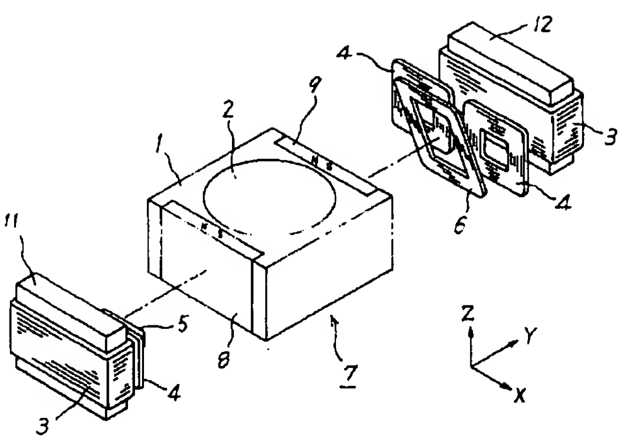


【図６】

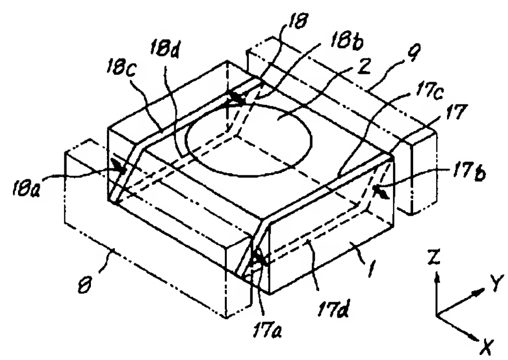


(a)　　　　(b)

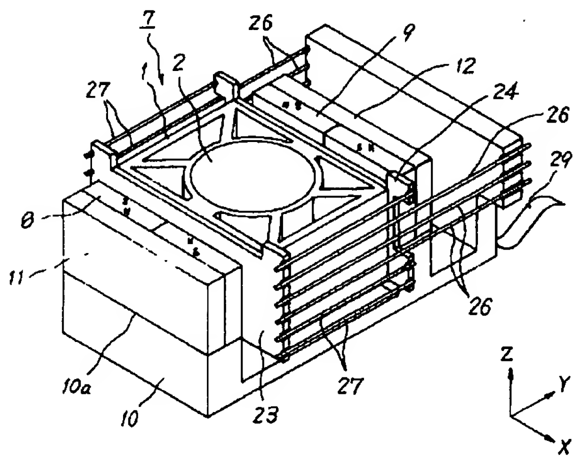
【図8】



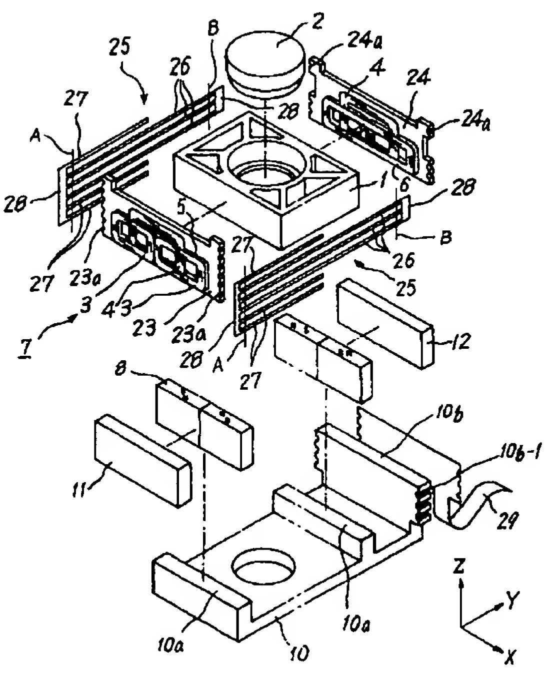
【図10】



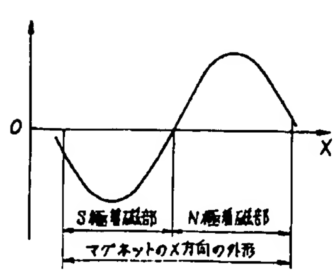
【図11】



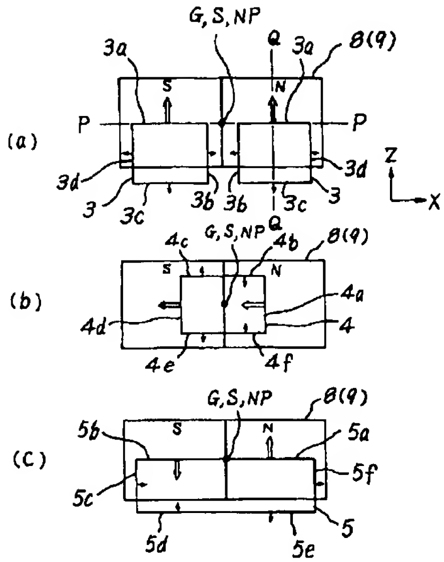
【図12】



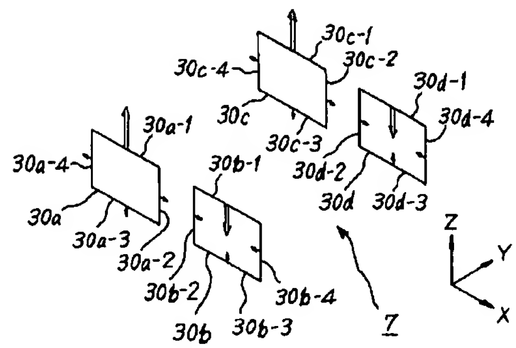
【図14】



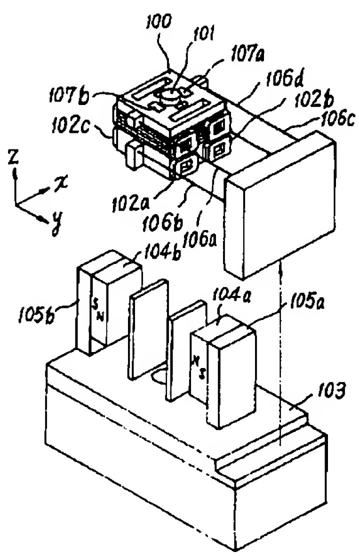
【図13】



【図16】



【図17】



【図18】